APPENDIX I

MONKFISH PLAN DEVELOPMENT TEAM DOCUMENT NUMBER 1

IMPLICATIONS OF REVISED ALTERNATIVE 3 TO REDUCE

FISHING MORTALITY WITH A DISCUSSION OF

THE BUYOUT PROGRAM, VESSELS WITH NO MONKFISH HISTORY,

AND REBUILDING SCHEDULES

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September 26, 1997

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Analysis Of Rebuilding Stock Biomass

The PDT used a length-based model to forecast stock rebuilding under various mortality scenarios which did not give reasonable results, most likely reflecting our inadequate understanding of the stock dynamics of monkfish. Without making unreasonable assumptions about the survey data, natural mortality, or size selectivity, the PDT was unable to calibrate the model to observed events.

The PDT's inability to forecast recovery timetables for alternative management measures, however, does not obviate the need to begin reductions in fishing mortality rates. Current fishing mortality rates are well above threshold levels. Even in the best of circumstances, several years of reduced fishing will be necessary to reduce fishing mortality sufficiently. During this period, additional research could be used to refine the model parameters and structure. A major concern for rebuilding concerns the tradeoff of time used to reduce fishing mortality to threshold levels versus the rebuilding time. In this sense, the precautionary principle would suggest that reductions to target fishing mortality rates should occur as rapidly as possible. This would provide the maximum period for recovery. If the recovery were successful, the productivity of the resource could be improved prior to the 10 year deadline under SFA.

A length based population projection model was developed to assess the implications of various management measures for stock rebuilding. The model uses a von Bertalanffy growth equation to define an annual growth increment for each length category. The length frequency distribution in any given year consists of individuals which grew into the defined length range plus those that remained there (i.e., the computed growth step was less than a unit interval) and minus those that grew out of the range. A Afrom-to≅ projection matrix identifies the starting length class in year t and the final length length class in year t+1. The probability of surviving between year t and t+1 is modeled using usual exponential model for population decay and estimated catches are based on the classic catch equation. Recruitment can be handled in a variety of ways but for testing purposes recruitment was treated as constant vector of numbers by length category over the range xx to yy, corresponding to lengths for zz year old monkfish. Growth parameters and size-specific partial recruitment rates, baseline fishing mortality rates were allowed to vary by stock area.

The model is considered to be an accurate depiction of the current level of knowledge of monkfish population dynamics and the fishery. Several hypothesized mechanisms of population regulation, such as cannibalism or size dependent natural mortality rate were not included owing to a lack of data. Such mechanisms may motivate innovative research or stimulate interesting theoretical advances but until their inclusion can be quantified, they have limited utility for management.

The Monkfish Technical Working Group initially hypothesized that the abundance levels and length frequencies observed during the 1970-79 period were characteristic of a stable period of abundance and mortality. The projection model provided a means of testing whether the estimated growth and mortality rates are consistent with this hypothesis. Lack of consistency would be evident if the projected population size structure failed to match the observed frequencies or if the overall population reached an equilibrium level significantly different from the target levels. Disagreement between observed and predicted could be induced by misspecification of recruitment, growth rates, natural mortality, fishing and discard mortality, or some combination of these factors. Initial runs of the model for northern and southern stocks indicated that the projected northern population would decline from the 1970-79 baseline period, whereas southern stocks would increase. This suggested that different types of mechanisms might be involved and/or the direction of change for a given parameter might be different for these stock areas.

One option initially explored was the possibility that size dependent partial recruitment patterns and discard rates may be responsible for the divergences. Since actual catches (i.e., landings plus discard) were poorly estimated, changes in the magnitude of mortality on smaller individuals might be responsible. Projection runs suggested relatively little influence of this mechanism on the equilibrium population size structure in either area. Sensitivity analyses with respect to growth rates also had limited effect.

Discussions within the PDT began to focus on the possibility of modifying the magnitude of recruitment and natural mortality rate. The first mechanism implies a difference in selectivity of the survey for small versus large monkfish. Varying selectivity of the dredge by habitat area could explain differences between northern and southern regions. The northern area is characterized by rocky substrate known to be desirable monkfish habitat. Moreover, the NEFSC trawl may be less efficient in such areas. Thus estimates of abundance may be underestimated in northern areas relative to southern areas. The second mechanism implies that the longevity of monkfish may exceed current estimates. The inverse relationship between longevity and natural mortality rate is well known in fish stocks. Therefore, the possibility existed that natural mortality rates could differ. Of course both recruitment levels and natural mortality rates could be misspecified and a series of simulation experiments were conducted to explore these options.

Simulation experiments suggested that stability for the northern populations could be obtained by increasing the number of one-year old recruits by 50% and decreasing natural mortality from 0.2 to 0.07. Stability was defined as a stable population within 10% of the 1970-79 target. In the south, stability was achieved by reducing average recruitment for the effect of a pulse of year classes in early 1970's. This pulse, although evident in both the fall and spring NEFSC surveys, ultimately failed to materialize as a significant increase population biomass. Therefore, exclusion of these data seemed plausible. A slight reduction of natural mortality to 0.17 was also required.

Collectively, the necessary changes in parameterization implied an inadequate understanding of the dynamics of the stocks. Since the derived conditions for stability were not unique (ie. other combinations of changes also could achieve stability) and since the scientific basis for such differences was weak, the PDT judged the current understanding of monkfish population dynamics to be inadequate for population projection. At the present time, the expected temporal for restoration of the stock to 1970-79 levels cannot be reliably predicted.

ALLOCATION ANALYSIS FOR ALTERNATIVE 3

Implications of Possession Limits and Days-at-sea Allocations to Manage Directed Fishing Effort and Bycatch

The Plan Development Team (PDT) examined individual trip data derived from 1995 and 1996 dealer records to evaluate the monkfish mortality implications for various combinations of trip limits, area restrictions, and days-at-sea allocations. The PDT chose four levels of trip limits, based on the statistical distribution of landings when monkfish was a small percentage of the total trip revenue. Three area constraints for multispecies trawl days-at-sea vessels were examined: a) regulated mesh areas with a boundary at 72°30' W longitude, b) Georges Bank (proposed areas in Draft Amendment 9), and c) no trip limit exemption for non-qualifying days-at-sea vessels.

The affect of days-at-sea limits in the limited access fishery was estimated based on the cumulative distribution of landings versus days-at-sea, ranging from 1 to 220 days. The PDT also examined the affect of days-at-sea restrictions with 10 different levels of trip limits for the directed fishery. Based on the expected landings and target allocations of Total Allowable Landings (TAL), optimal strategies of bycatch limits, days-at-sea allocations, and trip limits can be selected to meet the mortality objectives and produce equitable reductions in catch.

The analyses include the anticipated impact of the buyout program and the reduction in effort induced by counting monkfish effort against multispecies and scallop days-at-sea allocations. The landings of the 80 buyout vessels were excluded from the summary of expected landings by days-at-sea vessels that target monkfish or catch monkfish as a bycatch. In some cases, multispecies trawl vessels that fished for monkfish during 1995 and 1996 are expected to have insufficient unused multispecies days-at-sea to absorb their monkfish effort. The proportion of landings that cannot be absorbed by unused multispecies days was subtracted from the total monkfish expected landings. It assumes that other vessels will not increase fishing effort to take advantage of the reduced fishing activity by competing vessels. An additional 165 days are expected to be allocated to multispecies and scallop vessels as "monkfish-only" days. This additional allocation mitigated the expected reduction from monkfish counting in the existing days-at-sea programs for multispecies and scallop vessels.

Most options do not meet the 1998 (first year) mortality objectives without applying more conservative management strategies beyond that envisioned by the Council. They also are considerably further from the mortality objective to halt overfishing by year five. These results are described in more detail in the following sections. The Councils may want to consider more conservative management strategies to meet their goals. To achieve the year one interim mortality target, the Councils should consider:

- Lower bycatch trip limits
- Higher qualification thresholds for multispecies days-at-sea vessels

- Monkfish trip limits for all qualifying vessels
- Area closures to reduce bycatch or limit the directed fishery
- Eliminate the individual monkfish-only days-at-sea provision

The proposed management action does not include any reductions, other than the target TAL for limited access vessels, to reduce mortality beyond the year one objective. More conservative strategies are therefore necessary beyond what is currently included. To reduce monkfish mortality below the overfishing threshold, the Councils should consider:

- Large, permanent area closures
- Reductions in multispecies and scallop days-at-sea to conserve monkfish
- Lower trip limits for vessels permitted to target monkfish
- Allowing no directed monkfish fishery

Assumptions About TAL Projections

The fishery and the management programs underwent many changes between 1994 and 1996. The PDT was forced to make certain assumptions during the analysis of 1995 and 1996 data to evaluate the implications of various potential management decisions. Most of the assumptions that became necessary to analyze 1995 and 1996 data were caused by the absence of area fished and trip length information in the dealer records. Although it might be possible to derive this missing information from Vessel Trip Reports (VTR), it would require linking the two sources of data on a trip-by-trip basis. Previous efforts to link these data sets have been unsatisfactory and the 1994 and 1995 VTR data is not yet audited and final. These assumptions, along with the assumptions made in the Draft Environmental Impact Statement (DSEIS) analyses, are given below. The PDT believes that these assumptions are reasonable and will best approximate the effect of the potential management measures.

Broad assumptions

1. Throughout the analyses, a 70 percent discard mortality assumption was applied. Discard mortality as a proportion of the total discard appears to vary by gear, bottom type, duration of fishing, depth, and season. This actual discard mortality may be greater than this assumption in some areas and less in others. The value chosen by the PDT represents the more conservative value from near-shore, short-trawl sea trials by the New England Aquarium. Lower discard mortality rates imply that trip limits would be more effective in reducing total mortality, and vice versa.

   The analyses presented in the DSEIS assumed a zero discard mortality rate, because the intent of the trip limits was to deter fishing for monkfish. The selection of trip limits in the DSEIS was sufficiently high that 95 percent of trips catching monkfish as a bycatch would be able to land all the fish they customarily caught. The DSEIS hypothesized that the remaining trips would end early or fishing behavior would change (to avoid catching monkfish), due to the imposition of a trip limit. The PDT analysis assumes that all trips that are made by vessels without monkfish days-at-sea allocations will continue, irrespective of a monkfish trip limit and that discard mortality will be 70% of the fish discarded due to a trip limit.

2. The landings that are not included in the trip analysis (46% of total monkfish landings) occur primarily in the bycatch categories (vessel groups B and C). During 1995 and 1996, total monkfish landings come from three sources of information: a) dealer reports for landings from a single vessel for a single trip, b) dealer reports for landings from a single vessel for several trips[1], and c) state canvas data for dealers that are not required to report landings of federally-regulated species. Only data from the first source of information, i.e. records representing single trips, are amenable to trip limit and days-at-sea analyses.

   Some landings in state canvas data, came from vessels that may qualify for monkfish limited access, but the PDT cannot determine what fraction will continue under the monkfish limited access program. It is impossible to determine how many vessels that contributed to state canvas data will qualify for monkfish limited access, since the canvas data are insufficient to make this determination. Unless the fishing characteristics of vessels with landings not in the dealer data are different than other vessels, the PDT believes that the days-at-sea and trip limits for monkfish limited access vessels will be robust to changes in classification from 'bycatch' to 'limited access'.

Assumptions about monkfish caught as a non-target species

3. The PDT selected a subset of trips landing monkfish during 1995 and 1996 to examine customary bycatch and compatible trip limits to limit the amount of bycatch. Trips where monkfish accounted for 25 percent or less of the total trip revenue were examined for customary landings when vessels targeted other species. There is a significant, positive correlation between the amount of monkfish landed and the percent of trip revenue derived from monkfish landings. To the extent that trips with greater than 25 percent revenue are catching monkfish as a non-target species, the trip limits the PDT derived will underestimate reasonable bycatch limits and cause excessive discarding. To the extent that trips with less than 25 percent revenue are targeting monkfish, the trip limits will be lenient and ineffective for controlling fishing mortality.

4. Areas fished (by three digit statistical area) did not change between 1991-1994 and 1995-1996 for trips that caught monkfish as a non-target species. Area information is not recorded on dealer reports and it would be difficult to match records to the Vessel Trip Report under the current reporting system. When monkfish was landed as a non-target species during 1995 and 1996, the PDT assumed that the fishing effort was

[1] Dealers with federal permits to accept landings of federally-regulated species are required to report landings on a trip-by-trip basis. Partly due to customary practices (landings of vessels less than 5 gross registered tons were combined in the previous weighout landings reporting system) and partly due to unfamiliarity with the new procedures, there were some records in the dealer data that represented more than one trip.

distributed in the same proportion as was observed during 1991-1994, on a vessel-by-vessel basis. When no effort distribution information for a vessel was available, the PDT used a mean effort distribution for the port of landings, by vessels using the same fishing gear (i.e. trawl, dredge, gillnet, longline, etc.).

Although there is inter-annual variation in the distribution of fishing effort by three digit area, the data was aggregated into three large management areas for purposes of analysis (based on the different management boundaries found in Figure 2 and Figure 3). It does not appear that the management changes between these two time periods changed the distribution of fishing effort between the three areas when monkfish is landed as a non-target species. The majority of monkfish bycatch comes from vessels fishing under multispecies or scallop days-at-sea or vessels fishing for summer flounder and squid.

Area closures to conserve groundfish caused large effort shifts in groundfish and scallop fishing effort, but they appeared to occur within the monkfish management areas that the PDT analyzed. The closure of Area II caused notable shifts of fishing effort into the Gulf of Maine, but both the original effort distribution (1991-1994) and the relocated effort distribution (1995-1996) are in the northern fishery management area for monkfish. The closure of Area I and Nantucket Shoals to scallop vessels also caused notable shifts in fishing effort to the Mid-Atlantic. In this case, both the original effort distribution (1991-1994) and the relocated effort distribution (1995-1996) are in the southern fishery management area for monkfish. This shift in scallop fishing effort was also caused by low scallop recruitment on Georges Bank and high recruitment in the Mid-Atlantic. This effort shift may have some small implications about the monkfish trip limit exemption at 72°30' W longitude, but the exemption only applies to multispecies and combination vessels fishing with trawls.

5. Vessels will maintain the same characteristics of fishing for monkfish after Amendment 9 as they exhibited during 1995 and 1996, unless constrained by the potential management limitations (trip limits and day-at-sea allocations). In other words, the days-at-sea limits and monkfish trip limits are not expected to cause changes in the geographic distribution of fishing effort when monkfish is landed (or discarded) as a non-target species. Since the vessels are targeting other species, they will not make large-scale changes in the way they fish. Fishermen may relocate to avoid catching high amounts of monkfish since they cannot land them without the proper permit, but these changes are unlikely to cause fishermen to fish in the Gulf of Maine, for example, rather than in Southern New England.

Assumptions about directed fishing effort

6. Trip duration (counted as days absent) did not change between 1991-1994 and 1995-1996 for trips that targeted monkfish. Information about days-absent on a trip are not available on the Dealer Reports and cannot be easily linked to the call-in data under

the present reporting system. Monkfish limited access vessels, furthermore, do not participate in the call-in system because many do not have multispecies or scallop days-at-sea permits.

The PDT believes that the management changes that were implemented in 1994 and 1996 had an insignificant effect on the length of trips by a vessel. The PDT analysis assigned the average trip length during 1991 to 1994 to trips during 1995 and 1996 on an individual vessel basis. When no data for a vessel that target monkfish during 1995 and 1996 existed, the average trip length for trips targeting monkfish was assigned based on the port of landings and the fishing gear used by the vessel.

7. Areas fished on trips targeting monkfish during 1994 are not appropriate to use to assign to trips in 1995 and 1996 because of management changes (area closures and the exempted fishery provisions) that caused shifts in fishing effort. All of the multispecies regulated mesh area is now closed to vessels targeting monkfish, unless they are fishing on multispecies or scallop days-at-sea or they are participating in a seasonal, monkfish gillnet exempted fishery.

   The 1994 effort distribution on directed monkfish trips are also not appropriate for expected landings in 1998 because the 1994 rules are unlikely to be restored via Amendment 9. Therefore, it is impossible to decompose the expected landings by qualified monkfish limited access vessels by management area and days-at-sea or trip limit allocations should be based on an aggregate TAL for both management areas. The PDT, therefore, evaluated the effectiveness of days-at-sea allocations and trip limits for monkfish limited access vessels for both management areas together.

8. Trip limits for trips by non-qualifying vessels where monkfish revenue was greater than 50 percent of the total trip revenue creates no additional discards, i.e. trips end early or do not occur at all. For purposes of analyzing the target TALs in the various categories (relative to days-at-sea permits and monkfish qualification), the PDT assumed that future landings under the various management options would be equal to the trip limit when the landings for a trip in 1995 and 1996 exceeded the limit and monkfish revenue was greater than 50 percent of the total trip revenue.

   The PDT believes that this assumption is a reasonable approximation of the likely effect of trip limits for non-qualifying vessels. Some vessels that target monkfish under a trip limit and catches that exceed the trip limit will continue fishing for other species to "top-off" the trip or begin to high grade. In this regard, the PDT's assumption is liberal and discards will be greater than what is predicted. On the other hand, the PDT assumed that vessels will discard 100 percent of the monkfish that exceed the trip limit when monkfish contribute to less than 50 percent of the total trip revenue. On some of these trips, fishermen could move to fishing areas where monkfish are less abundant when they approach the monkfish trip limit. If they are targeting monkfish as a component of a mixed-species catch (monkfish may be 1/3 to ½ of the total trip revenue, for example), some fishermen may also shorten the trip to land their catch and then start a new trip. Thus discards, when compared to 1995-1996 trips without a trip limit, may be less than predicted by the PDT under these circumstances.

Description of Vessel Categories

The PDT segregated trips for analysis based on the vessel's permit status and qualification for monkfish limited access. Vessels were grouped into four possible combinations based on whether they had a multispecies or scallop days-at-sea permit and whether they would qualify for monkfish limited access based on their landings history during 1991 to 1994. Days-at-sea permit status was derived from the Northeast Region permit files as of July 1997. A flow-chart, showing the number of vessels in each category and how the PDT analyzed the days-at-sea and trip limit implications is show in Figure 1

The landings data for 1995 only became available recently and qualification was not reanalyzed for each vessel. The result reflects the vessels histories that are two months earlier than the qualification period in the draft amendment. The PDT does not feel that this slight mismatch will make meaningful changes to the results.

Vessel Category A - Days-At-Sea Vessels That Qualify For Monkfish Limited Access

There are 473 vessels with multispecies days-at-sea permits that would qualify for monkfish limited access by having at least 7,500 pounds tail-weight of monkfish landings during 1991-1994. An additional 24 vessels with scallop days-at-sea permits would qualify under revised option C[2]. Of the 473 vessels, 12 permits have been retired or are expected to be retired under the buyout program. Thus the total number of vessels that would be able to fish for monkfish without a trip limit during their existing days-at-sea would be 485. The predicted landings of these vessels were treated as if they had no trip limit, regardless of where they fished.

[2] Option C qualification criteria:

a) for vessels less than 51 gross registered tons, monkfish landings of at least 7,500 pounds tail-weight or 24,900 pounds whole weight, or
b) for any vessel, monkfish landings of at least 1,000 pounds tail-weight or 3,320 pounds whole weight on 50 or more trips, or
c) for any vessel, monkfish landings of at least 5,000 pounds tail-weight or 16,600 pounds whole weight on 8 or more trips, or
d) for any vessel, monkfish landings of at least 10,000 pounds tail-weight or 33,200 pounds whole weight on 5 or more trips.

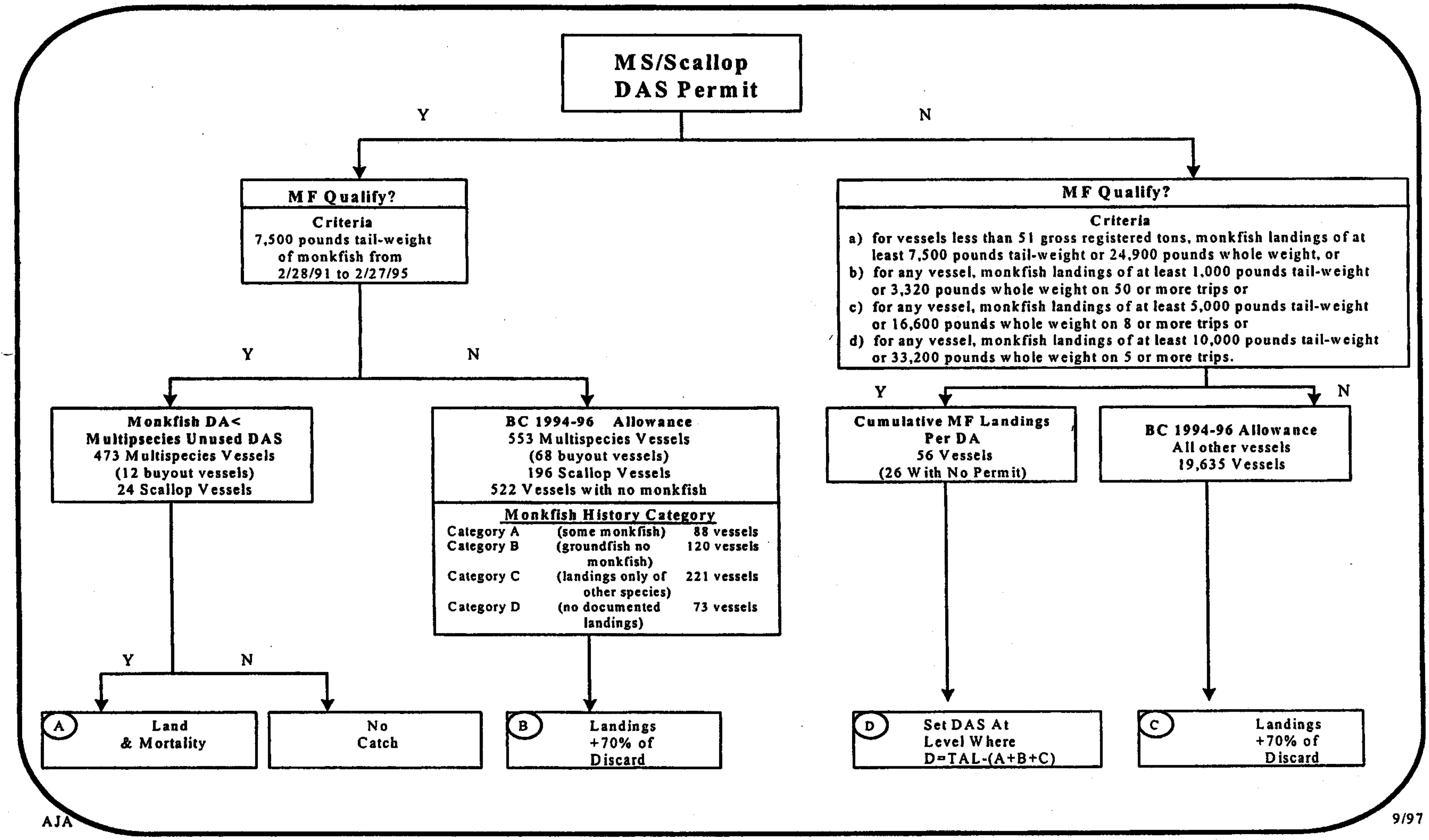

Figure 1. Classification of vessels under alternative 3 by monkfish qualification and permit status. Circled labels on the bottom row refer to vessel categories discussed in the document.

The PDT estimates that a total of 2,752 days used to fish for monkfish could be taken during unused multispecies days-at-sea or during monkfish-only days at sea. This total of unaffected monkfish days represents 58 percent of the 4,710 monkfish days taken per year during 1995 and 1996 by the 485 vessels in this category. Some vessels will have insufficient days, assuming they are allocated 88 multispecies days and have the same fishing activity as occurred during 1996, to absorb their monkfish fishing effort. This inability to fish for monkfish outside the days-at-sea program plus monkfish days absent that will be removed by the multispecies buyout program results in a reduction of 2,123 days.

An additional 165 days (6 percent of the unused multispecies days) was added to the total days-at-sea available to target monkfish. The DSEIS estimated that there would be 27 days-at-sea vessels that would qualify for individual monkfish-only days-at-sea with a 50 percent monkfish threshold. On average, these 27 vessels would receive 6.1 days per year based on their monkfish history, resulting in a total of 165 days.

The expected monkfish landings by vessels in Category A were reduced by 36 percent to account for the anticipated reduction in days available to target monkfish. These vessels accounted for 4,710 days while targeting monkfish. The subtraction of 2,123 days that could not be absorbed by the unused days and the addition of the 165 individual monkfish-only days results in a total of 2,752 days (58% of the observed days) that will be available to absorb the observed monkfish effort.

Vessel Category B - Days-At-Sea Vessels That Fail To Qualify For Monkfish Limited Access

The remaining 1,271 days-at-sea vessels fall into Category B. Of the vessels with observed monkfish landings, 553 vessels have multispecies days-at-sea permits and 196 vessels have scallop days-at-sea permits. An additional 522 vessels with days-at-sea permits have no history of landings monkfish during the qualification period, but may have landed monkfish during the analytical period, 1995-1996. The characteristics of these 522 vessels and their propensity for fishing for monkfish are reported below.

The PDT compared the observed landings of these vessels with various trip limit options, including the trip limit exemption options for multispecies vessels using trawls, to determine the expected monkfish landings after implementation of Amendment 9. These landings of monkfish as a non-target species were also affected by the anticipated effort reductions caused by existing management plans. These reductions in the expected catch without a monkfish trip limit were determined based on the target species and permit category of the vessel.

If the vessel has a multispecies days-at-sea permit and used trawl gear, the predicted landing, for purposes of analysis, was equal to the observed landing when the vessel fished in the proposed monkfish exemption area. This exemption area varied in each of the management options ranging from the exemption applying to all areas east of 72°30' W longitude to no trip limit exemption in any area.

For vessels in this category that targeted monkfish (monkfish revenue exceeded 50 percent of the total trip revenue) and its landing exceeded the trip limit, the predicted landing was equal to the trip limit and no increased discarding was assumed. For all other trips that exceeded the trip limit, the predicted landing was equal to the trip limit and the difference between the trip limit and the observed landing contributed to increased discarding. Seventy (70) percent of the discards were assumed to be dead and were deducted from the aggregate TAL for further analysis.

Vessel Category C - Vessels Without Days-At-Sea Permits That Fail To Qualify For Monkfish Limited Access

A total of 56 vessels without days-at-sea permits would qualify for monkfish limited access based on their landings history and qualification option C. Thirty (30) vessels presently have federal permits to fish in the EEZ and 26 have no federal permits. The PDT analyzed the landings of these 56 vessels relative to various potential days-at-sea allocations and trip limits. The total landings of these vessels were accumulated over a cumulative days-at-sea distribution ranging from 1 day to the maximum 225 days. The PDT assumed that no discard would occur by these vessels when they reached the monkfish trip limit or they fished outside the proposed monkfish days-at-sea program.

Additional vessels may qualify for limited access, but had insufficient history in the 1991-1994 weightout data to qualify. If the non-qualifying vessels had some data in the weighout system, their landings were combined with other Category D vessels.

Vessel Category D - Monkfish Limited Access Qualifiers

All other vessels with at least one pound of monkfish landings during 1995-1996, had no days-at-sea permit, and would fail to qualify for monkfish limited access fell into Category D. The PDT analyzed the proposed bycatch trip limits for a total of 19,635 Category D vessels. These ranged from a lobster or northern shrimp vessel that landed one monkfish to a vessel that began targeting monkfish after the control date and had considerable monkfish landings.

The treatment of landings and discard followed the same procedure used by the PDT for Category B vessels. Thus landings by non-qualifying vessels that target monkfish may be overestimated if they stop fishing as a result of the failure to qualify for monkfish limited access.

Days-At-Sea And Trip Limit Options For Monkfish Limited Access Vessels

The PDT evaluated nine different trip limit options to evaluate their effectiveness to reduce fishing mortality and the implications for a monkfish limited access fishery. The four levels of bycatch trip limits are summarized below:

Table 1. Trip limit options, expressed in pounds tail-weight, for managing monkfish bycatch in northern management zones. Whole weight equivalents are shown in parentheses.

Vessel group	Basis for choosing trip limit: 95th percentile[3] possession limit	95th percentile of total weight of fish onboard	99th percentile possession limit	99th percentile of total weight of fish onboard
Multispecies trawl	600 (1,992)	6 % (20 %)	1,200 (3,984)	9 % (30 %)
Multispecies gillnet	100 (332)	3 % (10 %)	200 (664)	6 % (20 %)
Scallop dredge	3,000 (9,960)	4 % (13 %)	4,000 (13,280)	5 % (17 %)
Scallop trawl	1,000 (3,320)	4 % (13 %)	1,400 (4,648)	4 % (13 %)
All other gears and permits	120 (398)	2 % (7 %)	250 (830)	4 % (13 %)

Table 2. Trip limit options, expressed in pounds tail-weight, for managing monkfish bycatch in southern management zones. Whole weight equivalents are shown in parentheses.

Vessel group	Basis for choosing trip limit: 95th percentile[4] possession limit	95th percentile of total weight of fish onboard	99th percentile possession limit	99th percentile of total weight of fish onboard
Multispecies trawl	600 (1,992)	6 % (20 %)	900 (2,988)	8 % (27 %)
Multispecies gillnet	100 (332)	1 % (3 %)	100 (332)	2 % (7 %)
Scallop dredge	1,600 (5,312)	4 % (13 %)	2,200 (7,304)	6 % (20 %)
Scallop trawl	700 (2,324)	3 % (10 %)	1,800 (5,976)	5 % (17 %)
All other gears and permits	150 (498)	2 % (7 %)	400 (1,328)	3 % (10 %)

The PDT also examined the expected landings and discards with respect to three different management strategies for multispecies trawl vessels. The oversight committee directed the PDT to advise on the implications of exempting multispecies vessels using trawls from qualifying to retain unlimited amounts of monkfish during multispecies days-at-sea. For purposes of analysis, multispecies vessels that would not qualify for monkfish limited access were treated as if they had no trip limit if they fished in an area to be exempted from the trip limit. The three management area options that the PDT examined are:

1. Multispecies vessels using trawls would be exempt from the monkfish bycatch trip limit, if they fished east of 72°30' W longitude. The trip limits for all other vessels and for all multispecies vessels that fish west of the management boundary would be

[3] 95th percentile of trips where monkfish revenue was 25 percent or less of the total revenue on a trip.

[4] 95th percentile of trips where monkfish revenue was 25 percent or less of the total revenue on a trip.

applicable based on the boundary line shown in Figure 2.

2. Multispecies vessels using trawls would be exempt from the monkfish bycatch trip limit, if they fished in the northern fishery management area, defined in Draft Amendment 9. The trip limits for all other vessels and for all multispecies vessels that fish west of the management boundary would be applicable based on the boundary line shown in Figure 3

3. No exemptions to the bycatch trip limit for non-qualifying vessels. The trip limits for all other vessels and for all multispecies vessels would be applicable based on the boundary line shown in Figure 3.

In all three cases, the expected landings were counted against target TALs for the biological management units described in Draft Amendment 9, depending on the location fished by the vessel during 1995-1996. In area management option 1 (72°30' W longitude), for example, vessels fishing in the Southwest Channel of Georges Bank would have the northern management area trip limits in Table 1. The expected landings, in this case, would be deducted from the southern biological management unit (described in Draft Amendment 9).

To show the implications of the potential management strategies, the PDT limited further discussion to five management options shown in Table 1. All other management strategies did not meet the first year mortality objectives. A more detailed summary of all the trials is included in Appendix II.

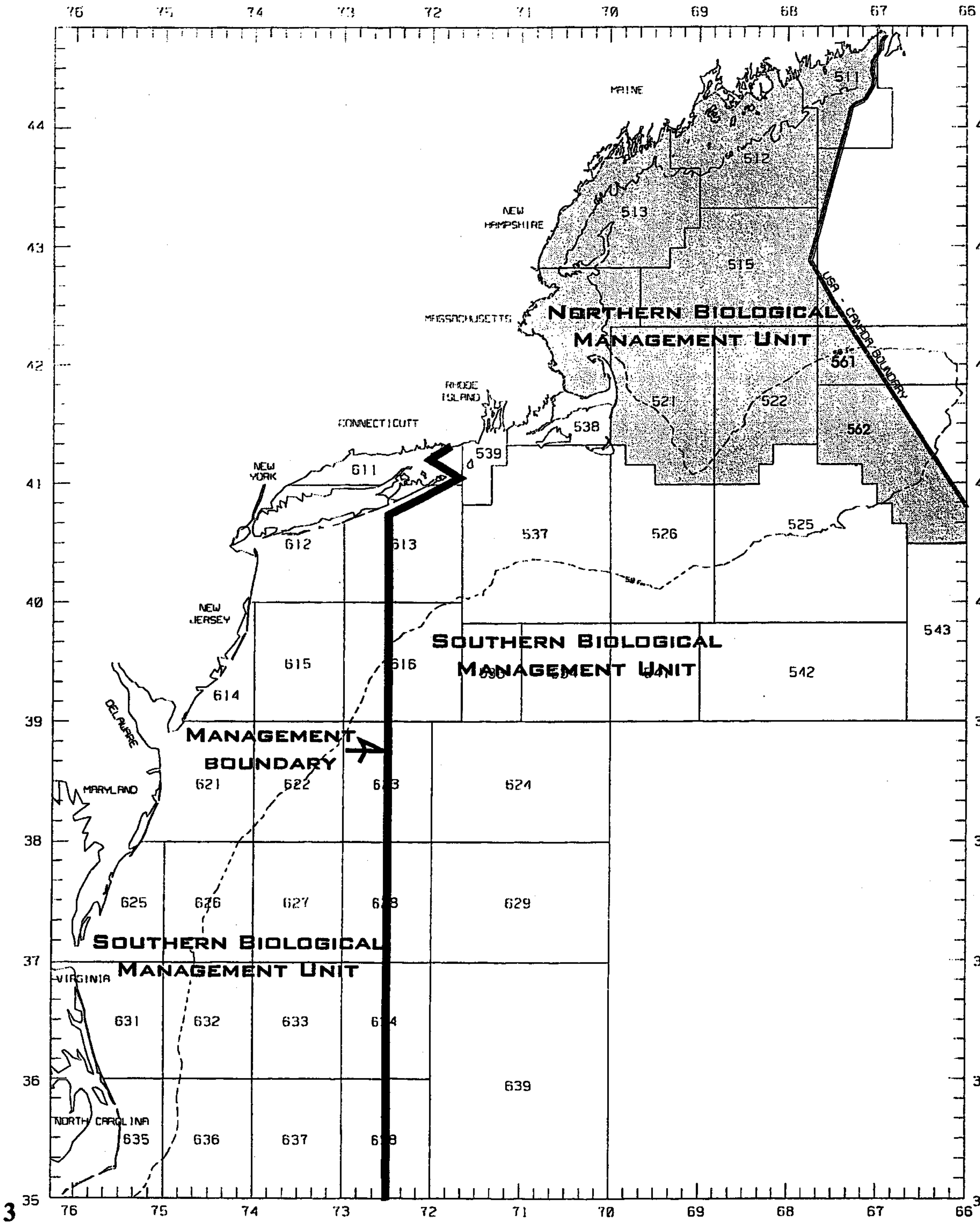

Figure 2. Revised management zones for monkfish showing the relationship to the biological management units for setting target TALs.

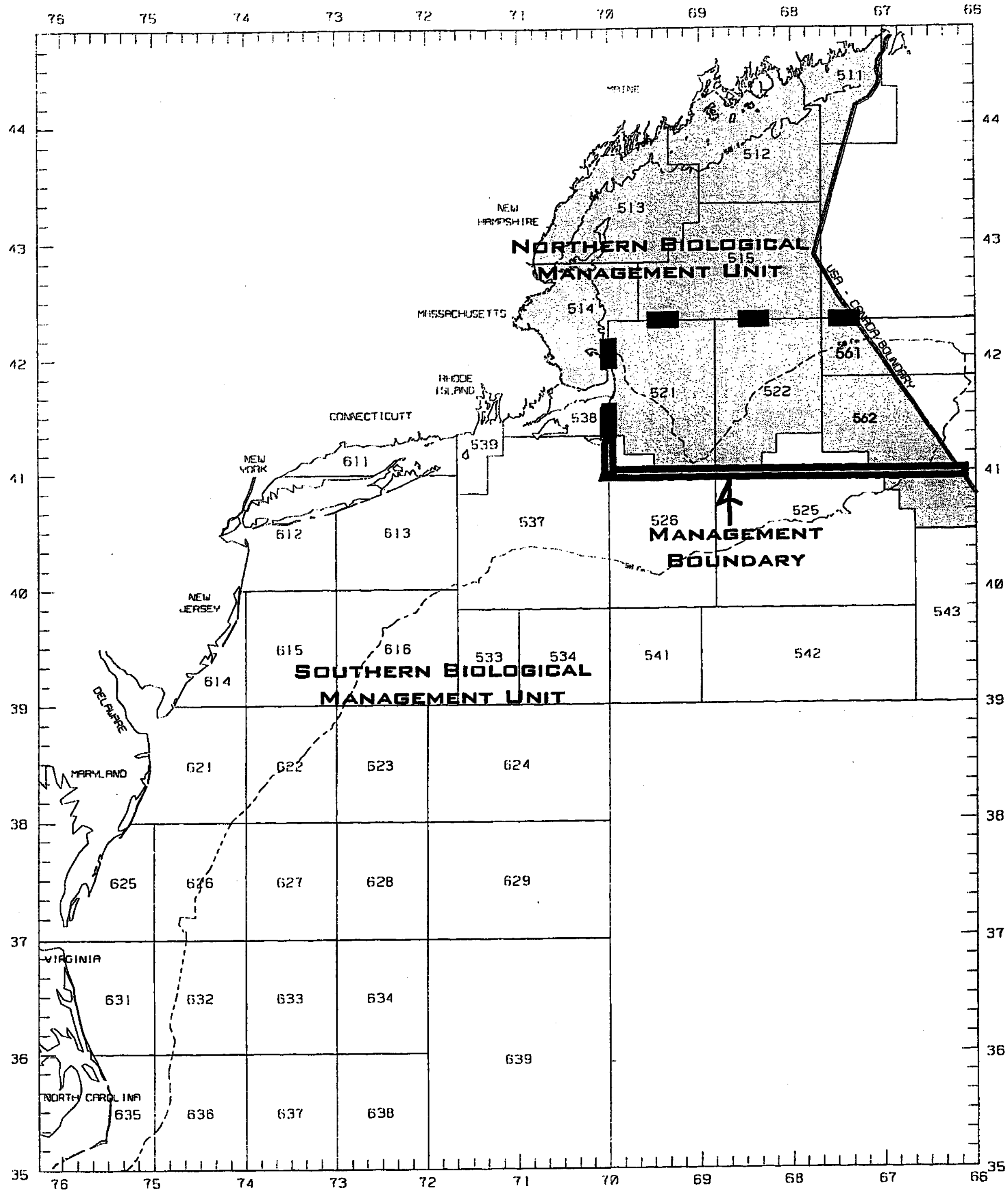

Figure 3. Draft Amendment 9 management zones for monkfish showing the relationship to the biological management units for setting target TALs. Bold blocks ( ) to the east of Massachusetts show the northern boundary where the southern area trip limits for scallop dredges would apply.

Table 3. Summary of bycatch trip limit trials.

Bycatch limit option	Multispecies trip limit option	Trawl days-at-sea trip limit		Gillnet days-at-sea trip limit		Scallop dredge days-at-sea trip limit		Discard to catch ratio
		North	South	North	South	North	South	
2	72°30' W	600 PTW[5]	600 PTW	100 PTW	100 PTW	3,000 PTW	1,600 PTW	7.2 %
6	Georges Bank	600 PTW	600 PTW	100 PTW	100 PTW	3,000 PTW	1,600 PTW	9.0 %
7	No automatic days-at-sea qualfication	6 % TWOFOB[6]	6 % TWOFOB	3 % TWOFOB	1 % TWOFOB	4 % TWOFOB	4 % TWOFOB	9.7%
8	No automatic days-at-sea qualfication	1,200 PTW	900 PTW	200 PTW	100 PTW	4,000 PTW	2,200 PTW	5.8 %
9	No automatic days-at-sea qualfication	9 % TWOFOB	8 % TWOFOB	6 % TWOFOB	2 % TWOFOB	4 % TWOFOB	5 % TWOFOB	8.5 %

[5] Pounds tail-weight
[6] Total weight of fish onboard

Expected Landings And Discards With Various Trip Limit Options

The PDT estimates that landings by Category A vessels would decline by 36 percent due to counting monkfish effort against multispecies and scallop days-at-sea. Landings for this category would decline from 4,833 mt to 3,092 mt. This reduction applies to all the trip limit options that the PDT evaluated.

Category B Vessels

Without a trip limit, landings of Category B vessels are expected to decline from 5,124 mt to 4,093 mt, due to reductions in days-at-sea allocations in the multispecies and scallop fisheries. As a result, the expected landings declines by 20.8 percent in the northern biological management unit and 19.7 percent in the southern biological management unit. This analysis takes into account the effect of unused days mitigating the mortality reduction caused by decreases in days-at-sea allocations. In the multispecies fishery, for example, the allocation of days-at-sea declined from 118,144 days in 1996 to 89,974 days in 1997, a 24 percent decline. The anticipated reduction in days used, however, is expected to decline from 44,061 days in 1996 to 40,341 days in 1997, an 8 percent decline. The PDT conducted a similar analysis for the scallop fishery.

Trip limits would further reduce the expected landings of Category B vessels and increase discards. The anticipated reductions in landings and the increases in discards are shown in Table 4.

Table 4. Expected landings and dead discards from Category B vessels in the first year of implementation with various trip limit and area management options.

	Northern biological management unit			Southern biological management unit		
Bycatch limit option	Expected landings	Dead discards	Percent reduction	Expected landings	Dead discards	Percent reduction
2	1,126	71	35.4%	1,695	188	42.5%
6	1,126	71	35.4%	1,380	290	49.0%
7	910	123	44.2%	1,380	290	49.0%
8	1,065	64	39.1%	1,678	157	43.9%
9	685	185	53.0%	1,249	199	55.8%

In year five, when the Councils anticipate halting overfishing, the trip limits have similar effects and there are additional small reductions in the expected landings and dead discards for Category B vessels due to more effort reductions in the scallop fishery. Without a trip limit, the anticipated monkfish landings are 3,820 mt, or a 25.2 percent reduction in the northern biological management unit and a 25.6 percent reduction in the southern biological management unit. In year five with the bycatch trip limit option 2, for example the PDT estimates 1,057 mt of landings and 63 mt of dead discards in the northern biological management unit. In the southern biological management unit, the PDT estimates that there would be 1,528 mt of landings and 172 mt of dead discards. Thus, the reduction in the TAL allocation for Category B vessels in year five would be 39.5 and 48.1 percent in the northern and southern biological management units, respectively. Details on the other options for year five are given in Appendix II.

Category C Vessels

The anticipated effects of bycatch trip limits for Category C were analyzed with the same methods that the PDT applied to Category B vessels, except no days-at-sea reductions were taken into account. The results for this category are given in Table 5.

Table 5. Expected landings and dead discards from Category C vessels in the first year of implementation with various trip limit and area management options.

Bycatch limit option	Northern biological management unit			Southern biological management unit		
	Expected landings	Dead discards	Percent reduction	Expected landings	Dead discards	Percent reduction
2	178	131	61.4%	246	83	76.8%
6	178	131	61.4%	233	98	76.6%
7	178	131	61.4%	233	98	76.6%
8	254	89	57.3%	423	66	65.4%
9	205	104	61.4%	154	72	84.1%

In year five, when the Councils anticipate halting overfishing, the trip limits have the same effects as estimated in Table 5. Details on the other options for year five are given in Appendix II.

Target Tals For Monkfish Limited Access Vessels - Implications For Days-At-Sea Allocations And Trip Limits

Applying the mortality objectives for the two biological management units for the first year to the landings in 1995-96 implies a target TAL of 11,671 mt. Since only 58 percent of total monkfish landings could be used in this analysis, the target TAL would be 6,314 mt. For all trip limit options except for options 3, 5, 7, and 9 (these options met the target TALs and allowed for an allocation to the monkfish limited access fishery), the expected landings and dead discards exceeded the aggregate TAL by 15 mt (option 6) to 546 mt (option 4). For the trials summarized by the PDT (Table 6), the shortfall ranged from 15 mt (option 6) to 304 mt (option 8). As a result, options 7 and 9 allow for an allocation of TAL to the monkfish limited access fishery. The proportion of future monkfish catches that would be discarded dead is shown in Table 3, and ranges from 4.2 percent (option 4) to 10.1 percent (option 3).

In all cases, the expected landings and dead discards exceed the aggregate TALs for the overfishing threshold in the northern and southern biological management units, ranging from

Table 15, 116 vessels did not land any monkfish or regulated groundfish (ie. Category C). During the period of analysis, these vessels appear 7,438 times in dealer data. The list of species that appear as having been landed on at least 1% of these occurrences is reported in Table 16. On any given trip more than one species may have been landed so the 7,438 records do not mean that these are associated with 7,438 trips. The 16 species listed in Table 16 account for 87% of all species that are reported as having been landed by these vessels. Lobster topped the list of all species with one-third of all occurrences in dealer reports.

Table 15. Principal Port State for Vessels that have Dealer Reports (March 1995 - December 1996).

State	No Monkfish Landings	Monkfish Landings
Connecticut	4	1
Massachusetts	112	34
Maryland	1	0
Maine	33	8
New Hampshire	5	5
New Jersey	16	3
New York	28	21
Rhode Island	25	1

Table 16. List of "Other Species"

Species Name	Frequency	Percent
Lobster	2491	33.5
Black Sea Bass	839	11.3
Scup	592	8.0
Bluefin Tuna	375	5.0
Shrimp	324	4.4
Tautog	286	3.8
Jonah Crab	268	3.6
Rock Crab	205	2.8
Fluke	198	2.7
Bluefish	192	2.6
Ocean Quahog	169	2.3
Menhaden	157	2.1
Bay Scallop	106	1.4
Weakfish	105	1.4
Conch	88	1.2
Spiny Dogfish	73	1.0

Level of Monkfish Participation (March, 1995-December, 1996)

The preceding analyses were only based on all-or-nothing criteria. The only issue was whether or not the vessel showed any history of monkfish landings. The following reports an analysis of the level of participation in monkfish. As before, only the 73 vessels with monkfish landings in the 1995-96 dealer reports are used for this analysis.

The 73 vessels landed just under 650,000 pounds over the 22 month period of analysis. Figure 9 shows the distribution of monkfish catch by vessel where vessels were sorted in ascending order according to total quantity of monkfish landings. Of the 73 only 3 landed more than 50,000 pounds and only 2 landed more than 150,000 pounds. The cumulative proportion of landings (Figure 10) shows that these 2 vessels landed 79% of the total monkfish landed by all 73 vessels. By contrast, 58 of the 73 vessels landed 1,500 pounds or less. The 73 vessels took a total of 1,149 trips upon which monkfish was landed. The distribution of landings on those trips is shown in Figure 11. On 819 (71%) trips total monkfish landed was 100 pounds or less and on 974 (85%) trips total monkfish landings were 600 pounds or less. The cumulative monkfish landings distribution is shown in Figure 12. At landings of 100 pounds or less landings across all vessels totaled 17,005 pounds. At landings of 600 pounds or less cumulative landings were 57,218 pounds.

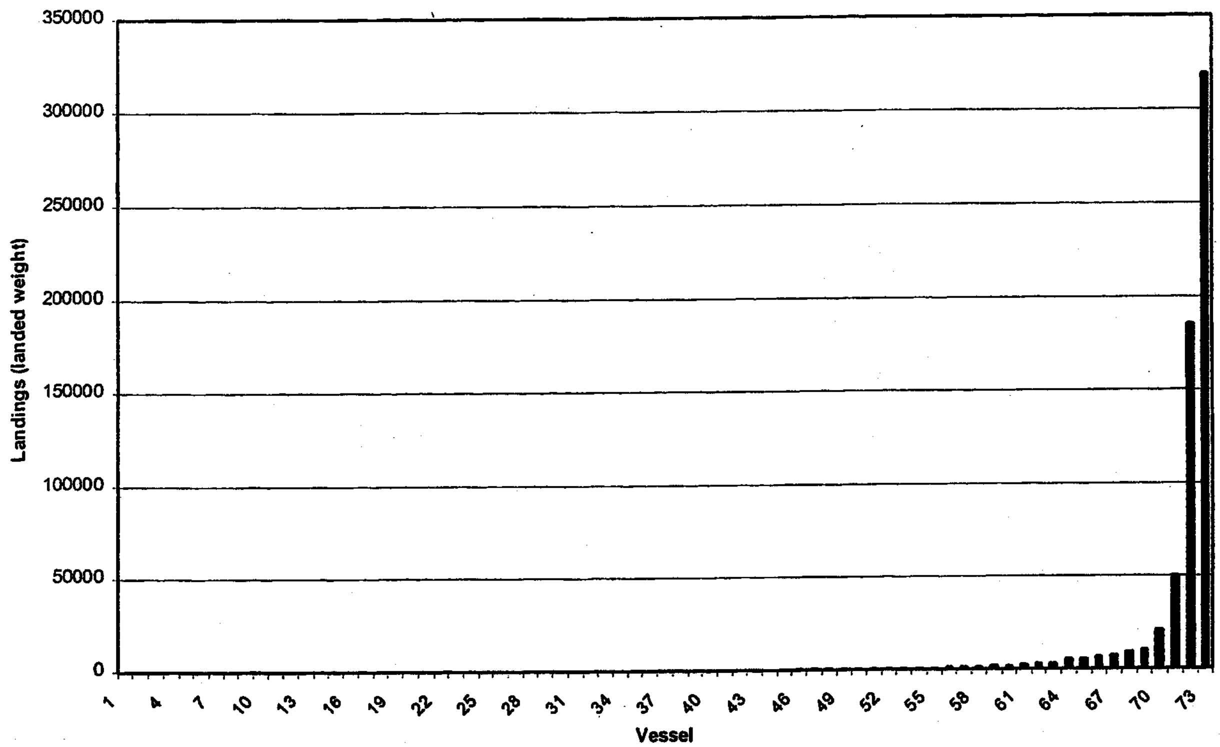

Figure 9. Monkfish landings (March 1995 to December 1996).

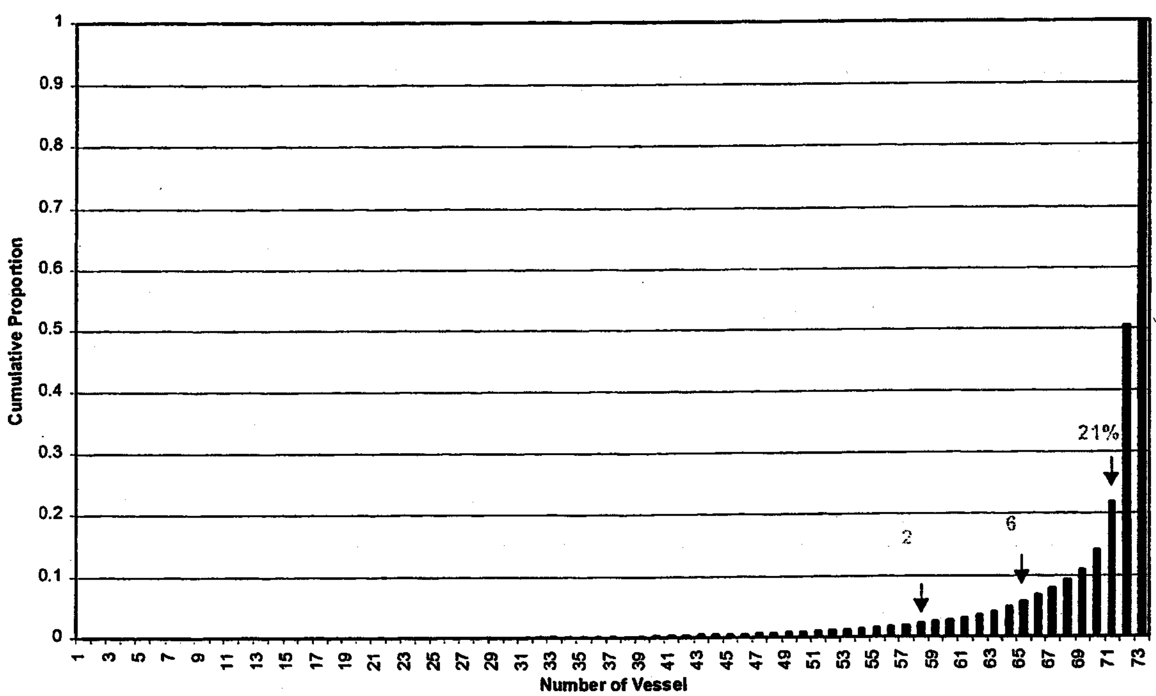

Figure 10. Cumulative proportion of landings (landed weight).

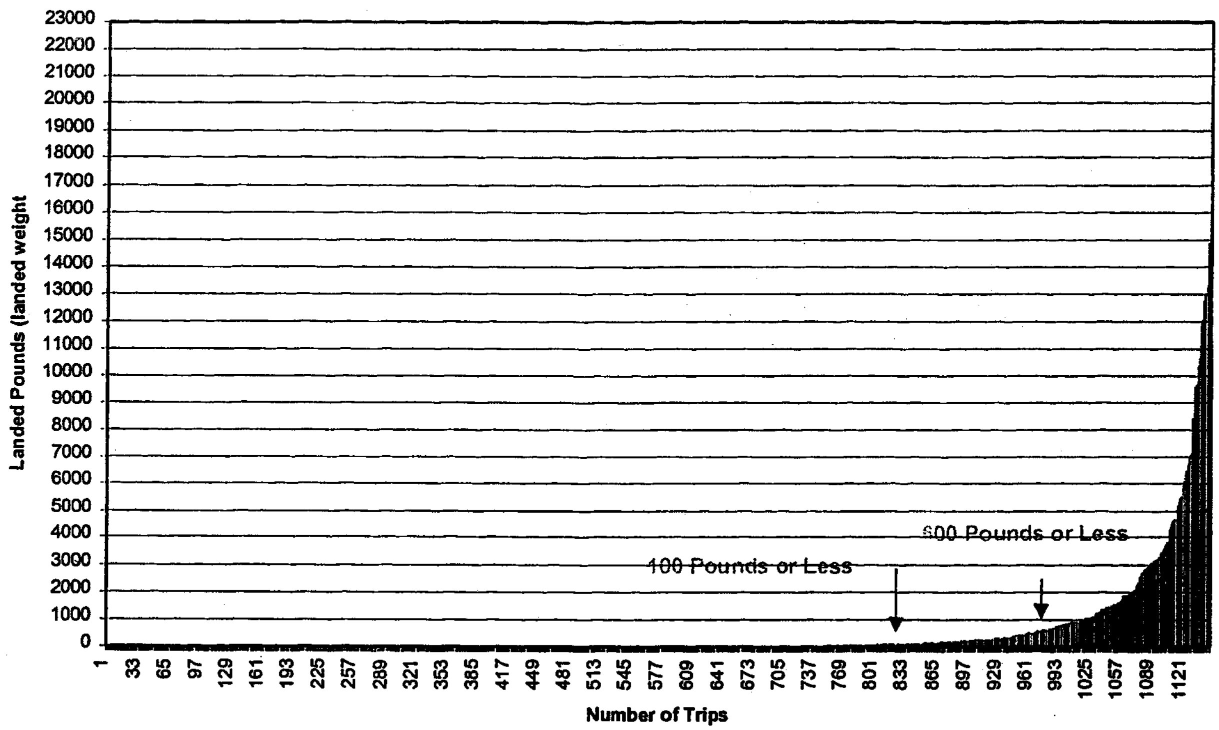

Figure 11. Landings on monkfish trips.

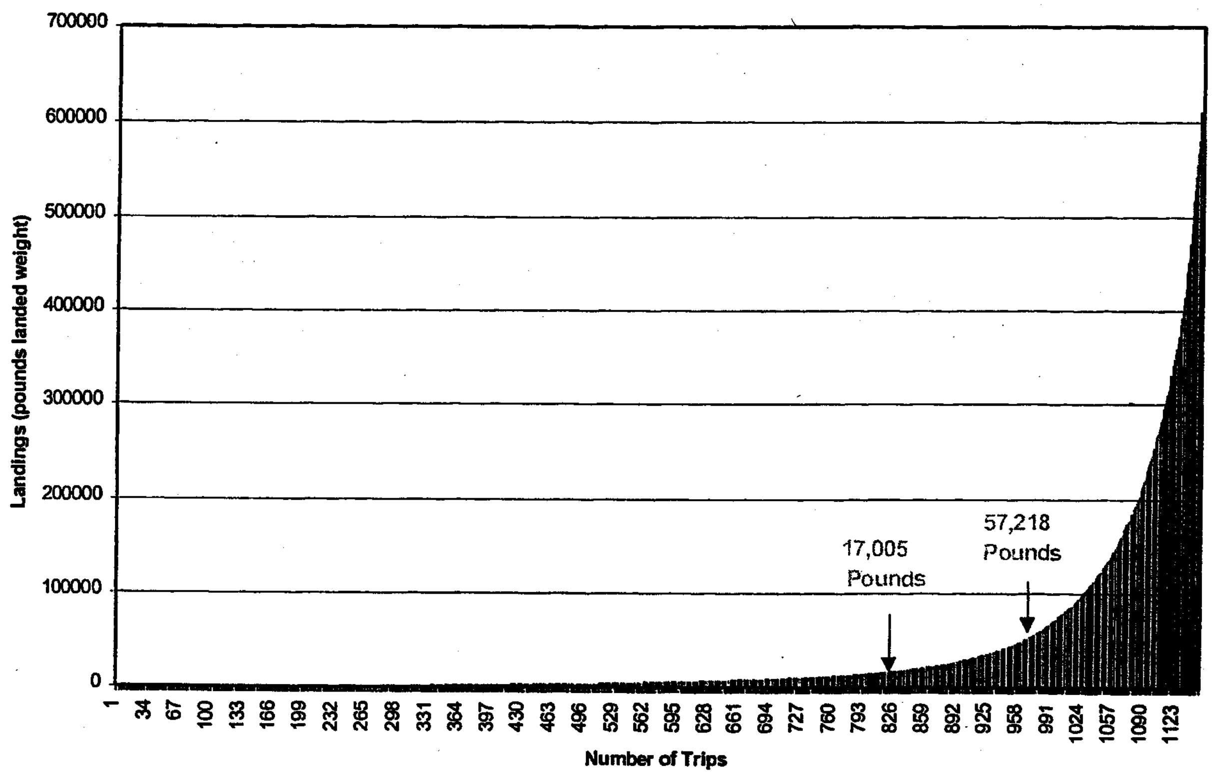

Figure 12. Cumulative monkfish landings (March 1995 to December 1996.

Assessment of Monkfish Targeting by Non-Monkfish-History Vessels

The PDT has begun exploratory work on development of a statistical-based predictive model to project under what conditions might a multispecies vessel with no history of monkfish participation begin to target monkfish. That analysis is in its very early stages of development and may not prove to be appropriate. Nevertheless, the preceding analysis does provide insights than can be drawn upon to develop reasoned qualitative assessments of the likelihood that a multispecies vessel might begin to target monkfish. It should be noted, however, that evaluation of the effectiveness of Alternatives 3 and 4 was based upon what these vessels did, not on what they might do. These assessments are offered below by monkfish history category.

Category A: Monkfish landings March, 1995 - December, 1996

Vessels in this category (88 vessels) have the highest likelihood of targeting monkfish. Analysis indicates that vessels in this category already show monkfish participation and at least a small number appear to have already begun targeting monkfish.

Category B: Landings of Multispecies but no Monkfish

Vessels in this category (120) have a moderate likelihood of targeting monkfish. Vessels engaged in groundfish have a higher likelihood of encountering monkfish during normal fishing operations and would have the opportunity to redirect to monkfish if conditions were advantageous to do so. Conditions that might change fishing patterns would include a change in vessel ownership, a change in vessel captain or crew, changes in groundfish or monkfish stock conditions, and changes in groundfish or monkfish markets.

Category C: Vessels Landing Only Other Species

Vessels in this category (221) have a low likelihood of targeting monkfish. The list of species landed by vessels in this category include many species for which incidental catches of monkfish are low due to the relative lack of interactions between monkfish and these species or due to the fact that monkfish are not susceptible to the predominant gear type used. Vessels might be converted to targeting monkfish under an ownership transfer or if stock or market conditions change as compared to monkfish conditions.

Category D: Vessels With no Recorded Landings of Any Species

Vessels in this category (73) have the lowest likelihood of targeting monkfish unless current ownership changes or unless there are changes in current stock or market conditions.

Category E: Vessels with Hook-Only Multispecies Permits

If, as intended, monkfish becomes a regulated species under the Multispecies FMP vessels in this category (127) will not be able to target monkfish using their only allowable gear for regulated groundfish.

APPENDIX I-A

STATISTICAL SUMMARY OF MONKFISH LANDINGS

PER TRIP BY GEAR AMD TARGET SPECIES

Table 11. 95th percentile of landings per trip by permit category and fishery, 1994-1995

95th percentile of monkfish landings (1995-1996) by qualification and permit type - Revised management areas - Multispecies regulated mesh area

Monkfish revenue is less than 25% of total revenue for each trip

	DASQUAL					DASNQUAL				
Gear	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct
Dogfish gillnet	68	216	65	2.9%	0.9%	427	166	50	2.4%	0.7%
Dogfish trawl	31	1,012	305	9.2%	2.8%	82	714	215	8.8%	2.6%
Fluke trawl	165	1,750	527	21.3%	6.4%	711	1,415	426	20.9%	6.3%
Hook	13	256	77	6.9%	2.1%	473	216	65	4.6%	1.4%
Other dredge	1	3,905	1,176	24.0%	7.2%	2	681	205	16.7%	5.0%
Other gear	6	362	109	13.5%	4.1%	120	306	92	14.9%	4.5%
Other gillnet	89	199	60	13.2%	4.0%	21	148	45	35.9%	10.8%
Other trawl	386	1,577	475	10.4%	3.1%	2,773	1,321	398	11.6%	3.5%
Traps	3	127	38	16.6%	5.0%	22	200	60	15.0%	4.5%
Groundfish gillnet	3,401	302	91	10.4%	3.1%	6,700	282	85	10.2%	3.1%
Groundfish trawl	2,796	1,799	542	24.7%	7.4%	10,464	1,826	550	20.9%	6.3%
Scallop dredge	1,559	10,292	3,100	14.2%	4.3%	174	9,163	2,760	13.2%	4.0%
Scallop trawl	39	3,433	1,034	9.1%	2.7%	43	3,187	960	11.6%	3.5%
Weighted average		2,712	817	15.9%	4.8%		1,257	379	15.6%	4.7%
Weighted average wo MSP & SC		1,274	384	12.4%	3.7%		1,068	322	11.6%	3.5%

	MFQUAL					MFNQUAL				
Gear	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct
Dogfish gillnet	76	114	34	2.6%	0.8%	152	179	54	2.8%	0.9%
Dogfish trawl	5	415	125	2.6%	0.8%	9	60	18	2.9%	0.9%
Fluke trawl	3	236	71	20.1%	6.0%	48	650	196	19.4%	5.8%
Hook			0		0.0%	172	136	41	7.8%	2.3%
Other dredge			0		0.0%	88	276	83	0.2%	0.1%
Other gear	5	4,216	1,270	5.0%	1.5%	37	149	45	3.5%	1.1%
Other gillnet	12	196	59	4.7%	1.4%	29	100	30	10.7%	3.2%
Other trawl	10	4,648	1,400	9.5%	2.9%	117	1,212	365	10.4%	3.1%
Traps	1	20	6	15.5%	4.7%	7	422	127	6.4%	1.9%
Groundfish gillnet	683	321	97	8.2%	2.5%	1,285	365	110	11.2%	3.4%
Groundfish trawl	132	3,330	1,003	27.1%	8.2%	588	2,001	603	21.1%	6.4%
Scallop dredge	82	10,609	3,195	14.5%	4.4%	45	9,396	2,830	13.9%	4.2%
Scallop trawl			0		0.0%			0		0.0%
Weighted average		1,596	481	10.7%	3.2%		903	272	12.4%	3.7%
Weighted average wo MSP & SC		727	219	4.1%	1.2%		394	119	6.8%	2.0%

Trip limits used for allocation analyses

	DASNQUAL				MFNQUAL			
Other gears					398	120	7%	2.0%
Groundfish gillnet	332	100	10%	3.0%				
Groundfish trawl	1,992	600	20%	6.0%				
Scallop dredge	9,960	3,000	13%	4.0%				
Scallop trawl	3,320	1,000	13%	4.0%				

95th percentile of monkfish landings (1995-1996) by qualification and permit type - Revised management areas - Mid-Atlantic regulated mesh area

Monkfish revenue is less than 25% of total revenue for each trip

	DASQUAL					DASNQUAL				
Gear	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct
Dogfish gillnet	87	212	64	3.5%	1.1%	486	206	62	2.6%	0.8%
Dogfish trawl	8	830	250	2.3%	0.7%	16	244	73	2.9%	0.9%
Fluke trawl	117	1,743	525	19.8%	6.0%	260	1,626	490	22.7%	6.8%
Hook	3	1,383	417	6.3%	1.9%	1	100	30	1.6%	0.5%
Other dredge			0		0.0%	5	22	7	0.0%	0.0%
Other gear			0		0.0%	4	33	10	7.4%	2.2%
Other gillnet	15	515	155	4.6%	1.4%	20	256	77	5.0%	1.5%
Other trawl	60	1,494	450	14.8%	4.4%	361	338	102	7.8%	2.3%
Traps			0		0.0%	7	415	125	8.2%	2.5%
Groundfish gillnet	30	1,571	473	4.6%	1.4%	63	292	88	3.6%	1.1%
Groundfish trawl	108	3,031	913	18.6%	5.6%	837	1,826	550	20.9%	6.3%
Scallop dredge	941	6,674	2,010	14.1%	4.2%	89	5,246	1,580	12.4%	3.7%
Scallop trawl	115	3,911	1,178	9.6%	2.9%	87	2,384	718	10.4%	3.1%
Weighted average		5,010	1,509	13.6%	4.1%		1,287	388	13.4%	4.0%
Weighted average wo MSP & SC		1,140	343	12.5%	3.8%		567	171	8.8%	2.6%

	MFQUAL					MFNQUAL				
Gear	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct	Trips	Catch/trip	TailWt/trip	POTFOB	TailWtPct
Dogfish gillnet	36	286	86	3.1%	0.9%	94	187	56	2.7%	0.8%
Dogfish trawl	6	159	48	3.6%	1.1%			0		0.0%
Fluke trawl	10	1,444	435	14.8%	4.5%	33	680	205	17.5%	5.3%
Hook	1	19	6	1.1%	0.3%	8	46	14	0.9%	0.3%
Other dredge			0		0.0%	186	308	93	0.3%	0.1%
Other gear			0		0.0%	4	378	114	3.2%	1.0%
Other gillnet	19	272	82	15.9%	4.8%	66	282	85	6.5%	2.0%
Other trawl	18	425	128	7.4%	2.2%	63	1,660	500	9.4%	2.8%
Traps			0		0.0%	7	475	143	39.9%	12.0%
Groundfish gillnet	12	193	58	2.1%	0.6%	14	375	113	4.5%	1.4%
Groundfish trawl	3	541	163	12.1%	3.6%	28	2,789	840	15.1%	4.5%
Scallop dredge	1	2,423	730	6.2%	1.9%	15	3,320	1,000	14.2%	4.3%
Scallop trawl			0		0.0%	1	531	160	3.9%	1.2%
Weighted average		423	128	7.4%	2.2%		692	209	5.6%	1.7%
Weighted average wo MSP & SC		428	129	8.0%	2.4%		490	147	4.8%	1.4%

Trip limits used for allocation analyses

	DASNQUAL				MFNQUAL			
Other gears					498	150	7%	2%
Groundfish gillnet	332	100	3%	1.0%				
Groundfish trawl	1,992	600	20%	6.0%				
Scallop dredge	5,312	1600	13%	4.0%				
Scallop trawl	2,324	700	10%	3.0%				

Table 12. 99th percentile of landings per trip by permit category and fishery, 1994-1995

99th percentile of monkfish landings (1995-1996) by qualification and permit type - Revised management areas - Multispecies regulated mesh area

Monkfish revenue is less than 25% of total revenue for each trip

Gear	DASQUAL Trips	DASQUAL Catch/trip	DASQUAL TailWt/trip	DASQUAL POTFOB	DASQUAL TailWtPct	DASNQUAL Trips	DASNQUAL Catch/trip	DASNQUAL TailWt/trip	DASNQUAL POTFOB	DASNQUAL TailWtPct
Dogfish gillnet	68	251	76	4.1%	1.2%	427	298	90	4.3%	1.3%
Dogfish trawl	31	1,710	515	12.3%	3.7%	82	1,278	385	8.8%	2.6%
Fluke trawl	165	2,490	750	34.6%	10.4%	711	2,722	820	20.9%	6.3%
Hook	13	255	77	6.9%	2.1%	473	399	120	16.4%	4.9%
Other dredge	1	3,905	1,176	24.0%	7.2%	2	681	205	16.7%	5.0%
Other gear	6	362	109	13.5%	4.1%	120	1,544	465	18.4%	5.5%
Other gillnet	89	598	180	23.9%	7.2%	21	299	90	41.7%	12.6%
Other trawl	386	2,391	720	21.5%	6.5%	2,773	2,374	715	17.5%	5.3%
Traps	3	127	38	16.6%	5.0%	22	425	128	22.1%	6.7%
Groundfish gillnet	3,401	762	230	16.6%	5.0%	6,700	624	188	18.8%	5.7%
Groundfish trawl	2,796	4,495	1,354	31.8%	9.6%	10,464	3,728	1,123	29.2%	8.8%
Scallop dredge	1,859	15,122	4,555	17.3%	5.2%	174	13,578	4,090	16.6%	5.0%
Scallop trawl	30	8,516	2,565	12.4%	3.7%	43	4,465	1,345	13.0%	3.9%
Weighted average		4,737	1,427	22.2%	6.7%		2,493	751	23.2%	7.0%
Weighted average wo MSP & SC		1,925	580	22.4%	6.7%		1,974	595	18.7%	5.0%

Gear	MFQUAL Trips	MFQUAL Catch/trip	MFQUAL TailWt/trip	MFQUAL POTFOB	MFQUAL TailWtPct	MFNQUAL Trips	MFNQUAL Catch/trip	MFNQUAL TailWt/trip	MFNQUAL POTFOB	MFNQUAL TailWtPct
Dogfish gillnet	76	251	76	5.1%	1.5%	152	299	90	4.6%	1.4%
Dogfish trawl	5	415	125	2.6%	0.8%	9	60	18	2.9%	0.9%
Fluke trawl	3	236	71	20.1%	6.0%	48	2,026	610	41.4%	12.5%
Hook			0		0.0%	172	465	140	19.4%	5.8%
Other dredge			0		0.0%	88	1,126	339	0.4%	0.1%
Other gear	5	4,216	1,270	5.0%	1.5%	37	166	50	4.1%	1.2%
Other gillnet	12	196	59	4.7%	1.4%	29	265	80	15.0%	4.5%
Other trawl	10	4,648	1,400	9.5%	2.9%	117	1,749	527	12.5%	3.8%
Traps	1	20	6	15.5%	4.7%	7	422	127	6.4%	1.9%
Groundfish gillnet	683	807	243	14.9%	4.5%	1,285	943	284	20.5%	6.2%
Groundfish trawl	132	6,142	1,850	32.3%	9.7%	588	4,757	1,433	31.6%	9.5%
Scallop dredge	82	11,736	3,536	17.5%	5.3%	45	10,797	3,252	14.2%	4.3%
Scallop trawl			0		0.0%			0		0.0%
Weighted average		2,395	721	16.4%	4.9%		1,955	589	20.9%	6.3%
Weighted average wo MSP & SC		820	247	5.8%	1.8%		825	249	12.4%	3.7%

Trip limits used for allocation analyses

	DASNQUAL Catch/trip	DASNQUAL TailWt/trip	DASNQUAL POTFOB	DASNQUAL TailWtPct	MFNQUAL Catch/trip	MFNQUAL TailWt/trip	MFNQUAL POTFOB	MFNQUAL TailWtPct
Other gears					830	250	13%	4.0%
Groundfish gillnet	664	200	20%	6.0%				
Groundfish trawl	3,984	1,200	30%	9.0%				
Scallop dredge	13,280	4,000	17%	5.0%				
Scallop trawl	4,648	1,400	13%	4.0%				

99th percentile of monkfish landings (1995-1996) by qualification and permit type - Revised management areas - Mid-Atlantic regulated mesh area

Monkfish revenue is less than 25% of total revenue for each trip

Gear	DASQUAL Trips	DASQUAL Catch/trip	DASQUAL TailWt/trip	DASQUAL POTFOB	DASQUAL TailWtPct	DASNQUAL Trips	DASNQUAL Catch/trip	DASNQUAL TailWt/trip	DASNQUAL POTFOB	DASNQUAL TailWtPct
Dogfish gillnet	87	541	163	4.3%	1.3%	488	345	104	4.3%	1.3%
Dogfish trawl	8	830	250	2.3%	0.7%	16	244	73	2.9%	0.9%
Fluke trawl	117	2,822	850	25.4%	7.7%	260	2,047	617	29.5%	8.9%
Hook	3	1,383	417	6.3%	1.9%	1	100	30	1.6%	0.5%
Other dredge			0		0.0%	5	22	7	0.0%	0.0%
Other gear			0		0.0%	4	33	10	7.4%	2.2%
Other gillnet	15	515	155	4.6%	1.4%	20	266	80	7.2%	2.2%
Other trawl	60	5,289	1,593	24.2%	7.3%	361	810	244	14.7%	4.4%
Traps			0		0.0%	7	415	125	8.3%	2.5%
Groundfish gillnet	30	3,291	991	9.0%	2.7%	63	402	121	4.5%	1.4%
Groundfish trawl	108	4,167	1,255	26.9%	8.1%	837	2,948	888	25.8%	7.8%
Scallop dredge	941	9,296	2,800	18.9%	5.7%	89	7,320	2,205	15.6%	4.7%
Scallop trawl	115	6,142	1,850	13.2%	4.0%	87	11,308	3,406	17.1%	5.2%
Weighted average		7,221	2,175	18.6%	5.6%		2,296	691	17.9%	5.4%
Weighted average wo MSP & SC		2,459	741	16.9%	5.1%		866	261	13.2%	4.0%

Gear	MFQUAL Trips	MFQUAL Catch/trip	MFQUAL TailWt/trip	MFQUAL POTFOB	MFQUAL TailWtPct	MFNQUAL Trips	MFNQUAL Catch/trip	MFNQUAL TailWt/trip	MFNQUAL POTFOB	MFNQUAL TailWtPct
Dogfish gillnet	36	300	90	3.4%	1.0%	94	240	72	6.0%	1.8%
Dogfish trawl	6	159	48	3.6%	1.1%			0		0.0%
Fluke trawl	10	1,444	435	14.8%	4.5%	33	1,295	390	20.6%	6.2%
Hook	1	19	6	1.1%	0.3%	8	48	14	0.9%	0.3%
Other dredge			0		0.0%	186	674	203	0.5%	0.1%
Other gear			0		0.0%	4	378	114	3.2%	1.0%
Other gillnet	19	272	82	15.9%	4.8%	66	2,059	620	9.7%	2.9%
Other trawl	18	425	128	7.4%	2.2%	63	4,236	1,276	21.4%	6.5%
Traps			0		0.0%	7	475	143	39.9%	12.0%
Groundfish gillnet	12	193	58	2.1%	0.6%	14	375	113	4.5%	1.4%
Groundfish trawl	3	541	163	12.1%	3.6%	28	3,884	1,170	15.8%	4.8%
Scallop dredge	1	2,423	730	6.2%	1.9%	15	3,320	1,000	14.2%	4.3%
Scallop trawl			0		0.0%	1	531	160	3.9%	1.2%
Weighted average		428	129	7.5%	2.3%		1,470	443	8.4%	2.5%
Weighted average wo MSP & SC		434	131	8.1%	2.4%		1,299	391	7.9%	2.4%

Trip limits used for allocation analyses

	DASNQUAL Catch/trip	DASNQUAL TailWt/trip	DASNQUAL POTFOB	DASNQUAL TailWtPct	MFNQUAL Catch/trip	MFNQUAL TailWt/trip	MFNQUAL POTFOB	MFNQUAL TailWtPct
Other gears					1,328	400	10%	3%
Groundfish gillnet	332	100	7%	2.0%				
Groundfish trawl	2,988	900	27%	8.0%				
Scallop dredge	7,304	2200	20%	6.0%				
Scallop trawl	5,976	1800	17%	5.0%				

Appendix II

Summary of Expected Landings and Discards

for Alternative 3

with Various Trip Limit and Area Management Options

Overfishing level summary

Expected 2002 monkfish catch with different management scenarios

Northern Fishery Management Area

1995-96 baseline 6,104
1998 TAL = 2,020

Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	DAS qualifying vessels (TAL A) Landings	DAS qualifying vessels (TAL A) Increase in Dead discard	DAS qualifying vessels (TAL A) Percent reduction	DAS non-qualifying vessels (TAL B) Landings	DAS non-qualifying vessels (TAL B) Increase in Dead discard	DAS non-qualifying vessels (TAL B) Percent reduction	Non-DAS qualifying vessels (TAL D) Allowable Landings	Non-DAS qualifying vessels (TAL D) Percent reduction	Non-DAS non-qualifying vessels (TAL C) Landings	Non-DAS non-qualifying vessels (TAL C) Increase in Dead discard	Non-DAS non-qualifying vessels (TAL C) Percent reduction
Baseline				2,417			1,852	-		1,035		800	-	
1	None	None	None	1,412		41.6%	1,385	-	25.2%	(1,372)	-100.0%	596	-	25.5%
2	Draft amendment	95th percentile	72-30 deg W	1,412		41.6%	1,057	63	39.5%	(815)	-100.0%	173	131	62.1%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	1,412		41.6%	838	146	46.9%	(661)	-100.0%	152	134	64.3%
4	Draft amendment	99th percentile	72-30 deg W	1,412		41.6%	1,152	30	36.2%	(909)	-100.0%	248	88	58.0%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	1,412		41.6%	893	112	45.8%	(700)	-100.0%	201	103	62.0%
6	Draft amendment	95th percentile	Georges Bank	1,412		41.6%	1,057	63	39.5%	(815)	-100.0%	173	131	62.1%
7	Draft amendment	95th percentile	Qualification required	1,412		41.6%	841	116	48.3%	(652)	-100.0%	173	131	62.1%
8	Draft amendment	99th percentile	Qualification required	1,412		41.6%	991	60	43.3%	(778)	-100.0%	248	88	58.0%
9	Draft amendment	99th percentile TWOFOB	Qualification required	1,412		41.6%	629	170	56.9%	(495)	-100.0%	201	103	62.0%

Southern Fishery Management Area

1995-96 baseline 8,134
1998 TAL = 1,679

Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	DAS qualifying vessels (TAL A) Landings	DAS qualifying vessels (TAL A) Increase in Dead discard	DAS qualifying vessels (TAL A) Percent reduction	DAS non-qualifying vessels (TAL B) Landings	DAS non-qualifying vessels (TAL B) Increase in Dead discard	DAS non-qualifying vessels (TAL B) Percent reduction	Non-DAS qualifying vessels (TAL D) Allowable Landings	Non-DAS qualifying vessels (TAL D) Percent reduction	Non-DAS non-qualifying vessels (TAL C) Landings	Non-DAS non-qualifying vessels (TAL C) Increase in Dead discard	Non-DAS non-qualifying vessels (TAL C) Percent reduction
Baseline				2,417			3,272	-		1,035		1,411	-	
1	None	None	None	1,412		41.6%	2,435	-	25.6%	(3,247)	-100.0%	1,279	-	9.4%
2	Draft amendment	95th percentile	72-30 deg W	1,412		41.6%	1,528	172	48.1%	(1,550)	-100.0%	236	82	77.5%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	1,412		41.6%	1,241	246	54.6%	(1,227)	-100.0%	123	85	85.3%
4	Draft amendment	99th percentile	72-30 deg W	1,412		41.6%	1,713	84	45.1%	(1,774)	-100.0%	389	56	68.5%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	1,412		41.6%	1,314	163	54.9%	(1,233)	-100.0%	155	68	84.2%
6	Draft amendment	95th percentile	Georges Bank	1,412		41.6%	1,231	262	54.4%	(1,346)	-100.0%	226	96	77.3%
7	Draft amendment	95th percentile	Qualification required	1,412		41.6%	1,231	262	54.4%	(1,346)	-100.0%	226	96	77.3%
8	Draft amendment	99th percentile	Qualification required	1,412		41.6%	1,520	141	49.2%	(1,672)	-100.0%	414	64	66.1%
9	Draft amendment	99th percentile TWOFOB	Qualification required	1,412		41.6%	1,096	180	61.0%	(1,023)	-100.0%	146	70	84.7%

1995-96 baseline all landings for both areas	Percent of landings used in analysis
26,303	54.1%

Monkfish days absent for category A vessels =	4,710	
Monkfish days absent that cannot be absorbed by multispecies days-at-sea =	-2,123	
Expected allocation of monkfish-only DAS to multispecies vessels =	165	
Days unaffected	2,752	58.4%
Remaining unused multispecies days-at-sea by category A vessels after adjusting for monkfish days absent =	10,781	

Category A trip limit option applied = 1
Category A trip limit options

	Limit	Expected landings
1	None	4,833
2	20,000	4,768
3	15,000	4,672
4	10,000	4,452
5	8,000	4,294
6	6,000	4,059
7	4,000	3,705
8	2,000	3,012
9	1,000	2,288
10	500	1,589

Total for both areas

Option	Aggegate TAL	Percent reduction	Expected Landings	Discard mortality	Percent of Catch
Baseline	2,071		14,238		
1	(4,619)	-100.0%	3,899		
2	(2,364)	-100.0%	3,452	447	10.9%
3	(1,886)	-100.0%	3,289	611	14.7%
4	(2,683)	-100.0%	3,642	258	6.4%
5	(1,933)	-100.0%	3,453	446	10.9%
6	(2,161)	-100.0%	3,349	551	13.3%
7	(1,898)	-100.0%	3,296	604	14.5%
8	(2,450)	-100.0%	3,546	353	8.7%
9	(1,518)	-100.0%	3,377	522	12.7%

Expected 1998 monkfish catch with different management scenarios

Northern Fishery Management Area

1995-96 baseline 6,104
1998 TAL = 2,832

Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	DAS qualifying vessels (TAL A) Landings	DAS qualifying vessels (TAL A) Increase in Dead discard	DAS qualifying vessels (TAL A) Percent reduction	DAS non-qualifying vessels (TAL B) Landings	DAS non-qualifying vessels (TAL B) Increase in Dead discard	DAS non-qualifying vessels (TAL B) Percent reduction	Non-DAS qualifying vessels (TAL D) Allowable Landings	Non-DAS qualifying vessels (TAL D) Percent reduction	Non-DAS non-qualifying vessels (TAL C) Landings	Non-DAS non-qualifying vessels (TAL C) Increase in Dead discard	Non-DAS non-qualifying vessels (TAL C) Percent reduction
Baseline				2,417			1,852	-		1,035		800	-	
1	None	None	None	1,412		41.6%	1,466	-	20.8%	(647)	-100.0%	602	-	24.8%
2	Draft amendment	95th percentile	72-30 deg W	1,412		41.6%	1,126	71	35.4%	(85)	-100.0%	178	131	61.4%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	1,412		41.6%	889	164	43.1%	77	-92.6%	155	136	63.7%
4	Draft amendment	99th percentile	72-30 deg W	1,412		41.6%	1,227	34	32.0%	(182)	-100.0%	254	89	57.3%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	1,412		41.6%	949	127	41.9%	36	-96.5%	205	104	61.4%
6	Draft amendment	95th percentile	Georges Bank	1,412		41.6%	1,126	71	35.4%	(85)	-100.0%	178	131	61.4%
7	Draft amendment	95th percentile	Qualification required	1,412		41.6%	910	123	44.2%	79	-92.4%	178	131	61.4%
8	Draft amendment	99th percentile	Qualification required	1,412		41.6%	1,065	64	39.1%	(50)	-100.0%	254	89	57.3%
9	Draft amendment	99th percentile TWOFOB	Qualification required	1,412		41.6%	685	185	53.0%	241	-76.7%	205	104	61.4%

Southern Fishery Management Area

1995-96 baseline 8,134
1998 TAL = 3,482

Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	DAS qualifying vessels (TAL A) Landings	DAS qualifying vessels (TAL A) Increase in Dead discard	DAS qualifying vessels (TAL A) Percent reduction	DAS non-qualifying vessels (TAL B) Landings	DAS non-qualifying vessels (TAL B) Increase in Dead discard	DAS non-qualifying vessels (TAL B) Percent reduction	Non-DAS qualifying vessels (TAL D) Allowable Landings	Non-DAS qualifying vessels (TAL D) Percent reduction	Non-DAS non-qualifying vessels (TAL C) Landings	Non-DAS non-qualifying vessels (TAL C) Increase in Dead discard	Non-DAS non-qualifying vessels (TAL C) Percent reduction
Baseline				2,417			3,272	-		1,035		1,411	-	
1	None	None	None	1,412		41.6%	2,627	-	19.7%	(1,848)	-100.0%	1,291	-	8.5%
2	Draft amendment	95th percentile	72-30 deg W	1,412		41.6%	1,695	188	42.5%	(141)	-100.0%	246	83	76.8%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	1,412		41.6%	1,385	277	49.2%	191	-81.6%	130	88	84.6%
4	Draft amendment	99th percentile	72-30 deg W	1,412		41.6%	1,887	92	39.5%	(364)	-100.0%	399	57	67.7%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	1,412		41.6%	1,464	185	49.6%	188	-81.8%	182	71	83.5%
6	Draft amendment	95th percentile	Georges Bank	1,412		41.6%	1,380	290	49.0%	70	-93.3%	233	98	76.6%
7	Draft amendment	95th percentile	Qualification required	1,412		41.6%	1,380	290	49.0%	70	-93.3%	233	98	76.6%
8	Draft amendment	99th percentile	Qualification required	1,412		41.6%	1,678	157	43.9%	(253)	-100.0%	423	66	65.4%
9	Draft amendment	99th percentile TWOFOB	Qualification required	1,412		41.6%	1,249	199	55.8%	398	-81.6%	154	72	84.1%

1995-96 baseline all landings for both areas	Percent of landings used in analysis
26,303	54.1%

Monkfish days absent for category A vessels =	4,710	
Monkfish days absent that cannot be absorbed by multispecies days-at-sea =	-2,123	
Expected allocation of monkfish-only DAS to multispecies vessels =	165	
Days unaffected	2,752	58.4%
Remaining unused multispecies days-at-sea by category A vessels after adjusting for monkfish days absent =	10,761	

Category A trip limit option applied = 1
Category A trip limit options

	Limit	Expected landings
1	None	4,833
2	20,000	4,768
3	15,000	4,672
4	10,000	4,452
5	8,000	4,294
6	6,000	4,059
7	4,000	3,705
8	2,000	3,012
9	1,000	2,288
10	500	1,589

Total for both areas

Option	Aggegate TAL	Percent reduction	Expected Landings	Discard mortality	Percent of Catch
Baseline	2,071		14,238		
1	(2,496)	-100.0%	6,314		
2	(226)	-100.0%	5,842	472	7.2%
3	267	-87.1%	5,649	665	10.1%
4	(546)	-100.0%	6,043	271	4.2%
5	224	-89.2%	5,827	487	7.5%
6	(15)	-100.0%	5,725	589	9.0%
7	148	-92.8%	5,672	642	9.7%
8	(304)	-100.0%	5,939	375	5.8%
9	639	-69.1%	5,755	559	8.5%

Appendix III

Summary of Expected Landings and Discards

for Alternative 4

with Various Trip Limit and Area Management Options

Expected 1998 monkfish catch with different management scenarios

Northern Fishery Management Area

1995-96 baseline 10,172
1998 TAL = 4,720

				DAS qualifying vessels (TAL A)			DAS non-qualifying vessels (TAL B)			Non-DAS qualifying vessels (TAL D)		Non-DAS non-qualifying vessels (TAL C)		
Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	Landings	Increase in Dead discard	Percent reduction	Landings	Increase in Dead discard	Percent reduction	Allowable Landings	Percent reduction	Landings	Increase in Dead discard	Percent reduction
Baseline				1,323			7,014	-		1,036		800	-	
1	None	None	None	841		36.4%	5,078	-	27.6%	(1,801)	-100.0%	602	-	24.8%
2	Draft amendment	95th percentile	72-30 deg W	841		36.4%	4,584	114	33.0%	(1,127)	-100.0%	178	131	61.4%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	841		36.4%	4,314	217	35.4%	(942)	-100.0%	155	136	63.7%
4	Draft amendment	99th percentile	72-30 deg W	841		36.4%	4,707	67	31.9%	(1,236)	-100.0%	254	89	57.3%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	841		36.4%	4,367	173	35.3%	(969)	-100.0%	205	104	61.4%
6	Draft amendment	95th percentile	Georges Bank	841		36.4%	4,584	114	33.0%	(1,127)	-100.0%	178	131	61.4%
7	Draft amendment	95th percentile	Qualification required	841		36.4%	1,954	1,005	57.8%	612	-40.9%	178	131	61.4%
8	Draft amendment	99th percentile	Qualification required	841		36.4%	2,678	653	52.5%	206	-80.1%	254	89	57.3%
9	Draft amendment	99th percentile TWOFOB	Qualification required	841		36.4%	1,857	887	60.9%	827	-20.1%	205	104	61.4%

Southern Fishery Management Area

1995-96 baseline 10,562
1998 TAL = 4,521

				DAS qualifying vessels (TAL A)			DAS non-qualifying vessels (TAL B)			Non-DAS qualifying vessels (TAL D)		Non-DAS non-qualifying vessels (TAL C)		
Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	Landings	Increase in Dead discard	Percent reduction	Landings	Increase in Dead discard	Percent reduction	Allowable Landings	Percent reduction	Landings	Increase in Dead discard	Percent reduction
Baseline				1,323			6,793	-		1,036		1,411	-	
1	None	None	None	841		36.4%	5,550	-	18.3%	(3,161)	-100.0%	1,291	-	8.5%
2	Draft amendment	95th percentile	72-30 deg W	841		36.4%	4,079	439	33.5%	(1,166)	-100.0%	246	83	76.8%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	841		36.4%	3,809	483	38.8%	(829)	-100.0%	130	88	84.6%
4	Draft amendment	99th percentile	72-30 deg W	841		36.4%	4,402	252	31.5%	(1,430)	-100.0%	399	57	67.7%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	841		36.4%	3,974	322	36.8%	(848)	-100.0%	162	71	83.5%
6	Draft amendment	95th percentile	Georges Bank	841		36.4%	1,972	833	58.7%	546	-47.4%	233	98	76.6%
7	Draft amendment	95th percentile	Qualification required	841		36.4%	1,972	833	58.7%	546	-47.4%	233	98	76.6%
8	Draft amendment	99th percentile	Qualification required	841		36.4%	2,770	463	52.4%	(40)	-100.0%	423	66	65.4%
9	Draft amendment	99th percentile TWOFOB	Qualification required	841		36.4%	2,063	523	61.9%	870	-16.0%	154	72	84.1%

1995-96 baseline all landings for both areas	Percent of landings used in analysis
26,303	78.8%

Monkfish days absent for category A vessels =	1,866	
Monkfish days absent that cannot be absorbed by multispecies days-at-sea =	-680	
Expected allocation of monkfish-only DAS to multispecies vessels =	0	
Days unaffected	1,186	63.6%
Remaining unused multispecies days-at-sea by category A vessels after adjusting for monkfish days absent =	4,949	

Category A trip limit option applied = 1

Category A trip limit options

	Limit	Expected landings
1	None	2,646
2	20,000	2,603
3	15,000	2,554
4	10,000	2,467
5	8,000	2,412
6	6,000	2,329
7	4,000	2,179
8	2,000	1,811
9	1,000	1,384
10	500	961

Total for both areas

Option	Aggregate TAL	Percent reduction	Expected Landings	Discard mortality	Percent of Catch
Baseline	2,071		20,734		
1	(4,962)	-100.0%	9,240		
2	(2,293)	-100.0%	8,474	766	8.0%
3	(1,771)	-100.0%	8,317	923	9.6%
4	(2,666)	-100.0%	8,776	464	4.9%
5	(1,818)	-100.0%	8,572	669	7.0%
6	(582)	-100.0%	8,065	1,175	12.1%
7	1,157	-44.1%	7,174	2,067	20.4%
8	166	-92.0%	7,971	1,269	13.0%
9	1,696	-18.1%	7,656	1,585	16.0%

Expected 2002 monkfish catch with different management scenarios

Northern Fishery Management Area

1995-96 baseline 10,172
1998 TAL = 3,367

Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	DAS qualifying vessels (TAL A) Landings	Increase in Dead discard	Percent reduction	DAS non-qualifying vessels (TAL B) Landings	Increase in Dead discard	Percent reduction	Non-DAS qualifying vessels (TAL D) Allowable Landings	Percent reduction	Non-DAS non-qualifying vessels (TAL C) Landings	Increase in Dead discard	Percent reduction
Baseline				1,323			7,014	-		1,035		800	-	
1	None	None	None	841		36.4%	1,385	-	80.3%	545	-47.3%	596	-	25.5%
2	Draft amendment	95th percentile	72-30 deg W	841		36.4%	4,504	105	34.3%	(2,390)	-100.0%	178	131	61.5%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	841		36.4%	4,255	196	36.6%	(2,210)	-100.0%	152	134	64.3%
4	Draft amendment	99th percentile	72-30 deg W	841		36.4%	4,621	62	33.2%	(2,492)	-100.0%	248	88	58.0%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	841		36.4%	4,323	155	36.2%	(2,256)	-100.0%	201	103	62.0%
6	Draft amendment	95th percentile	Georges Bank	841		36.4%	4,504	105	34.3%	(2,385)	-100.0%	173	131	62.1%
7	Draft amendment	95th percentile	Qualification required	841		36.4%	1,874	996	59.1%	(647)	-100.0%	173	131	62.1%
8	Draft amendment	99th percentile	Qualification required	841		36.4%	2,592	648	53.8%	(1,050)	-100.0%	248	88	58.0%
9	Draft amendment	99th percentile TWOFOB	Qualification required	841		36.4%	1,793	869	62.1%	(440)	-100.0%	201	103	62.0%

Southern Fishery Management Area

1995-96 baseline 10,562
1998 TAL = 2,440

Option	Management area boundary	Trip limit basis	Multispecies trip limit boundary	DAS qualifying vessels (TAL A) Landings	Increase in Dead discard	Percent reduction	DAS non-qualifying vessels (TAL B) Landings	Increase in Dead discard	Percent reduction	Non-DAS qualifying vessels (TAL D) Allowable Landings	Percent reduction	Non-DAS non-qualifying vessels (TAL C) Landings	Increase in Dead discard	Percent reduction
Baseline				1,323			6,793	-		1,035		1,411	-	
1	None	None	None	841		36.4%	2,435	-	64.2%	(2,115)	-100.0%	1,279	-	9.4%
2	Draft amendment	95th percentile	72-30 deg W	841		36.4%	3,891	420	36.5%	(3,029)	-100.0%	236	82	77.5%
3	Draft amendment	95th percentile TWOFOB	72-30 deg W	841		36.4%	3,648	446	39.7%	(2,703)	-100.0%	123	85	85.3%
4	Draft amendment	99th percentile	72-30 deg W	841		36.4%	4,207	243	34.5%	(3,296)	-100.0%	389	56	66.5%
5	Draft amendment	99th percentile TWOFOB	72-30 deg W	841		36.4%	3,807	295	39.6%	(2,726)	-100.0%	155	68	84.2%
6	Draft amendment	95th percentile	Georges Bank	841		36.4%	1,806	799	61.7%	(1,326)	-100.0%	226	96	77.3%
7	Draft amendment	95th percentile	Qualification required	841		36.4%	1,806	799	61.7%	(1,326)	-100.0%	226	96	77.3%
8	Draft amendment	99th percentile	Qualification required	841		36.4%	2,593	444	55.3%	(1,916)	-100.0%	414	64	66.1%
9	Draft amendment	99th percentile TWOFOB	Qualification required	841		36.4%	1,893	500	64.8%	(1,009)	-100.0%	146	70	84.7%

1995-96 baseline all landings for both areas	Percent of landings used in analysis
26,303	78.8%

Monkfish days absent for category A vessels =	1,866	
Monkfish days absent that cannot be absorbed by multispecies days-at-sea =	-680	
Expected allocation of monkfish-only DAS to multispecies vessels =	-	
Days unaffected	1,186	63.6%

Remaining unused multispecies days-at-sea by category A vessels after adjusting for monkfish days absent = 10,781

Category A trip limit option applied = 1

Category A trip limit options

	Limit	Expected landings
1	None	2,646
2	20,000	2,603
3	15,000	2,554
4	10,000	2,467
5	8,000	2,412
6	6,000	2,329
7	4,000	2,179
8	2,000	1,811
9	1,000	1,384
10	500	961

Total for both areas

Option	Aggregate TAL	Percent reduction	Expected Landings	Discard mortality	Percent of Catch
Baseline	2,071		20,734		
1	(1,670)	-100.0%	5,807		
2	(5,419)	-100.0%	5,071	736	12.0%
3	(4,912)	-100.0%	4,947	860	13.9%
4	(5,788)	-100.0%	5,358	449	7.5%
5	(4,982)	-100.0%	5,186	621	10.2%
6	(3,711)	-100.0%	4,678	1,129	17.9%
7	(1,973)	-100.0%	3,786	2,021	30.3%
8	(2,965)	-100.0%	4,564	1,243	19.6%
9	(1,449)	-100.0%	4,265	1,542	23.8%

APPENDIX II

MONKFISH PLAN DEVELOPMENT TEAM
DOCUMENT NUMBER 2

BIOLOGICAL IMPLICATIONS OF MONKFISH MANAGEMENT ALTERNATIVES

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Chairman
Joseph M. Brancaleone

Executive Director
Paul J. Howard

MEMORANDUM

Date: March 23, 1998

TO: Monkfish Oversight Committee

FROM: Monkfish PDT

SUBJECT: Biological implications of monkfish management alternatives
PDT Document #2

The Plan Development Team has completed its re-evaluation of the mortality reductions that would be expected from the proposed management alternatives for monkfish. September 1997 was the last time that the PDT advised the committee on the effects of the proposed days-at-sea limits, trip limits, and qualification criteria. This information was presented in PDT Document #1. Council staff revised those analyses to give the oversight committee advice on different management options between September and December 1997. Most of these changes were relatively minor and appeared to give satisfactory results.

Alternatives examined:

The present document gives the estimated impacts, evaluated against the TAC equivalents for the mortality reduction objectives. The PDT analyzed three management alternatives:

1. <u>The final alternative, last modified by the oversight committee on February 12 and approved by the Councils on February 26 and March 11, 1998</u>. The management measures in this alternative include the qualification criteria, days-at-sea allocations, and trip limits specified in the "Draft Summary of Proposed Action to Manage Monkfish", dated February 18, 1998. Five-hundred and ninety-eight (598) vessels would qualify for monkfish limited access, according to the NMFS weighout files during 1991-1995. The number and characteristics of the vessels that qualify for monkfish limited access are summarized in the PDT memo dated February 25, 1998.

2. <u>The preferred alternative in the public hearing document</u>. The management measures in this alternative include the qualification criteria, days-at-sea allocations, and trip limits specified in the public hearing document. Five-hundred and four (504) vessels would qualify for monkfish limited access, according to the NMFS weighout files during 1991-1995 (See attached PDT memo dated February 25, 1998).

3. <u>The non-preferred alternative in the public hearing document</u>. The management measures in this alternative include the qualification criteria, days-at-sea allocations, and trip limits specified in the public hearing document. Four-hundred and forty-six (446) vessels would qualify for monkfish limited access, according to the NMFS weighout files during 1991-1995 (See attached PDT memo dated February 25, 1998).

Summary of results:

The estimated mortality reductions for the three alternatives examined by the PDT are roughly equivalent and fall somewhat short of the overfishing definition fishing mortality threshold. Behavioral responses or changes in market and biological conditions could not be analyzed and may help achieve the overfishing mortality thresholds. The final alternative, without directed fishery trip limits, is estimated to fall significantly short of the mortality goals for 1999 to 2002 (years 1-3), especially for the Northern Fishery Management Area.

The Council may want to consider strengthening the directed fishery trip limits and/or reducing the monkfish days-at-sea allocations to improve the chances for meeting these interim targets and curtailing the overfished condition of the stock. Management options that the Councils may want to consider include:

- Reducing the number of vessels that qualify for monkfish limited access.
- Reducing the number of vessels that can fish in the northern area without a trip limit, or the amount of days-at-sea that can be fished without a trip limit.
- Reducing the directed fishery trip limit.
- Reducing the trip limits for non-qualifying vessels, in cases where the currently proposed trip limits are unconstraining and are expected to have very little discard mortality. High trip limits for non-qualifying vessels have little value in inducing fishing behavior changes to avoid catching monkfish when it is not a target species.
- Eliminating the running clock.

The alternatives are expected to give roughly equivalent results, with regard to monkfish mortality reduction when the Council proposes to end overfishing. In the Northern Fishery Management Area (Table 1), the estimated mortality reductions range from 47 to 50 percent for the three alternatives. In the Southern Fishery Management Area (Table 2), the estimated mortality reductions range from 59 to 61 percent for the three alternatives. These estimated effects compare with the mortality reduction objectives of 68 and 78 percent, respectively. While all the alternatives appear to fall somewhat short of the overfishing definition thresholds, there are many behavioral responses that the PDT cannot analyze that would effect the mortality rates actually realized by the management program. Some of these responses (for example fishermen using fewer days-at-sea to target monkfish or moving away from concentrations of small monkfish) would have beneficial effects. Other responses may increase fishing mortality, or could causes shifts in fishing activity between the two management areas.

The three management alternatives do have different effects in the first two years, however. In year 1, the non-preferred alternative is estimated to achieve greater reductions in fishing mortality (35% in the southern area and 38% in the northern area), than the other two alternatives. More vessels qualify in the preferred alternative than the non-preferred alternative. The final alternative has the most vessels that qualify for monkfish limited access, but the directed fishery trip limits do not become effective until half-way through year 2.

The final alternative and non-preferred alternatives are estimated to have equivalent mortality reductions in the southern area (Table 2), 42 and 41 percent, respectively. In the northern area (Table 1), the non-preferred alternative is still estimated to cause more mortality reduction (37 percent) than the other alternatives. The mortality reduction for the final alternative in the northern area is estimated to increase from 20 to 29 percent. In the southern area, the mortality reduction is expected to double from 22 to 42 percent, largely due to the proposed implementation of directed fishery trip limits.

More details for each of the alternatives, by permit type, gear, and qualification status, are given in Tables 3 and 4. Examination of the estimated effects on landings and discard mortality could reveal how the proposed rules could effect individual sectors of the monkfish fishery. Further description would, however, require much more discussion and is beyond the scope of the work presented here.

Methods:

A considerable number of changes and enhancements were necessary to use the best available (more recent) data and take into account the different management structure in the final alternative. The most notable management change that required different programming was the 40 days-at-sea annual allocation for targeting monkfish in the southern management area.

For purposes of analysis, the PDT assumed that a trip would be classified as a 'monkfish trip' if it landed more monkfish than would be allowed by the proposed bycatch limits (specified by permit category). Thus, any monkfish landings that exceeded the bycatch trip limits would have used a monkfish days-at-sea, provided that the vessel could use a monkfish-only, a multispecies, or a scallop days-at-sea for that purpose. The revised analysis also now allows for the allocation of up to 40 monkfish-only days to combination vessels.

The analysis could not account for the reduction in fishing effort for scallop and multispecies vessels that currently fish their entire annual days-at-sea allocation. In this case, the vessel that qualifies for monkfish limited access would have to choose to use the lower allocations of days-at-sea to fish for multispecies/scallops or monkfish. To account for this source of effort reduction, the PDT assumed that the expected effort reduction for multispecies (8.4 percent in 1998) and scallops (16.7 Percent in 1998 and 26.9 percent in 2000) will also have the same impact on monkfish effort. For vessels that would have unused multispecies or scallop days-at-sea (based on their call-in days-at-sea reporting during 1996), the ability (or inability) to use unused multispecies or scallop days-at-sea was computed directly within the program.

The second major change that affected the former PDT analysis was the application of daily trip limits for vessels that qualify for monkfish limited access. Especially for the monkfish-only vessel group, the dealer data do not capture all trips made by vessels and of those it does capture, the days absent data is rather sketchy. The best that the PDT could do was to use mean trip lengths (days absent) for qualifying vessels that appear in the Vessel Trip Report (VTR) data base. For the purposes of allocating trip length to 1995-1996 by qualifying vessels, the VTR data was summarized by gear used and management area (northern and southern).

The following list documents the modifications that were necessary for the final analyses that will be included in the FMP documentation:

- The analysis is based on the landings history of qualifying vessels during the 1995-1996 calendar year. Dealer and call-in data for 1997 is preliminary and not yet available for this purpose.

- Permit status was based on the permit records as of February 1, 1998 and the list of buyout vessels is current through February 23, 1998.

- The period analyzed for automatic qualification, based on existing NMFS data, exactly matches the qualification period in the proposed measures. The DSEIS was inaccurate by a two-month shift, January 1, 1991 to December 31, 1995, since 1996 data was not yet available when the DSEIS analyses were performed.

- The analysis incorporates monkfish-only days-at-sea limits for scallop and multispecies vessels that qualify for monkfish limited access. Through the 1998 public hearings, the multispecies and scallop vessels could use their entire day-at-sea allocations to target monkfish, if they did not use them for targeting scallops and multispecies, respectively.

- The analysis incorporates directed fishing daily trip limits, as specified in the "Summary of Proposed Measures" document. No trip limits for monkfish limited access vessels were specified in previous proposals.

- The revised analysis estimates bycatch on trips that would be likely to continue when there would be no monkfish days available (they were used on other trips):
  - Multispecies day-at-sea vessels: landings of multispecies occurred and therefore used a multispecies days-at-sea.
  - Scallops day-at-sea vessels: the revenue derived from scallops was greater than the revenue derived from monkfish.
  - Monkfish-only vessels: the revenue derived from the landings of monkfish was less than 50% of total revenue.

- The analysis estimates gear-specific discard mortality for trips when a bycatch trip limit would apply.

- Trip limits on monkfish-only trips are assumed to shorten the trip length by the ratio of the trip limit to the original monkfish landings. In other words, the trip limit for the directed fishery was not assumed to create discards. Instead, the PDT assumed that the trip would end early or the fishing behavior would change to avoid exceeding the daily trip limit. This has a similar effect as would the running clock, but there was not way to explicitly account for a running clock.

- Conversion of scallop trips to monkfish-only trips was expected (or assumed) only if the revenue derived from monkfish landings was double that derived from scallop landings. This high threshold was chosen to reflect the higher cost of converting a dredge vessel into one that is capable of targeting monkfish with a trawl or gillnet.

- If a vessel did not have a history, during 1995-1996, of targeting monkfish, the PDT assumed that the vessel would not use any unused multispecies or scallop days-at-sea to target monkfish.

The analysis could not account for the following factors that could effect future monkfish mortality rates:

- The analysis does not attempt to estimate changes in behavior that would cause shifts in fishing effort, e.g. between groundfish and monkfish, or between the northern and southern management areas.

- The analysis could not directly estimate the effects of planned reductions in multispecies and scallop days-at-sea allocations. The PDT estimated that these days-at-sea reductions would apply equally to multispecies and monkfish or scallop and monkfish, for the respective vessel permit categories. The analysis did, however, take into account the reduction in unused days-at-sea (ones that could be used to target monkfish).

Table 1. Northern Fishery Management Area: Summary of estimated landings and discards after applying the proposed qualification criteria, days-at-sea limits, and trip limits. These results are compared with the total 1995-196 landings for vessels in each category to estimate monkfish mortality reduction.

	Vessel classification	Mortality reduction objective (Public Hearing Document)	Final alternative (February 18, 1998 summary)			Preferred alternative (Public Hearing Document)			Non-preferred alternative (Public Hearing Document)		
			Expected landings (mt)	Expected discards (mt)	1991-1995 Landings (mt)	Expected landings (mt)	Expected discards (mt)	1991-1995 Landings (mt)	Expected landings (mt)	Expected discards (mt)	1991-1995 Landings (mt)
Year 1	DAS Qualifiers		6,398	19	7,991	6,035	34	7,341	5,337	50	6,532
	DAS Non-qualifiers		706	706	49	1,599	1,437	139	2,913	1,571	388
	Monkfish-only		416	115	708	282	44	425	416	115	708
	Bycatch fisheries		104	33	389	169	172	950	104	33	389
	Total		7,624	68	9,590	7,472	173	10,254	6,908	438	11,274
	Percent reduction	**55%**	**20%**			**25%**			**35%**		
Year 2	DAS Qualifiers		5,654	19	7,991	5,930	32	7,341	5,173	45	6,532
	DAS Non-qualifiers		697	697	49	1,599	1,372	133	2,913	1,516	416
	Monkfish-only		284	115	708	282	44	425	416	115	708
	Bycatch fisheries		104	33	389	169	168	950	104	33	389
	Total		6,739	68	9,590	7,302	165	10,254	6,689	461	11,274
	Percent reduction	**55%**	**29%**			**27%**			**37%**		
Year 3	DAS Qualifiers		2,546	1,663	7,991	2,177	1,609	7,341	2,882	868	6,496
	DAS Non-qualifiers		656	656	68	1,599	1,212	195	2,913	1,481	425
	Monkfish-only		68	243	708	32	111	425	68	243	708
	Bycatch fisheries		104	33	389	168	165	950	104	33	389
	Total		3,374	1,731	9,590	3,389	1,804	10,254	4,363	1,293	11,238
	Percent reduction	**68%**	**47%**			**49%**			**50%**		

Table 2. Southern Fishery Management Area: Summary of estimated landings and discards after applying the proposed qualification criteria, days-at-sea limits, and trip limits. These results are compared with the total 1995-196 landings for vessels in each category to estimate monkfish mortality reduction.

	Vessel classification	Mortality reduction objective (PUBLIC HEARING DOCUMENT)	Final alternative (February 18, 1998 summary)			Preferred alternative (Public Hearing Document)			Non-preferred alternative (Public Hearing Document)		
			Expected landings (mt)	Expected discards (mt)	1991-1995 Landings (mt)	Expected landings (mt)	Expected discards (mt)	1991-1995 Landings (mt)	Expected landings (mt)	Expected discards (mt)	1991-1995 Landings (mt)
Year 1	DAS Qualifiers		6,193	22	7,853	5,393	21	6,569	5,368	30	6,588
	DAS Non-qualifiers		1,104	1,104	212	3,200	2,720	259	5,753	1,400	643
	Monkfish-only		1,023	105	1,352	902	73	1,152	1,023	105	1,352
	Bycatch fisheries		86	60	935	98	172	1,341	86	60	935
	Total		8,406	234	11,053	8,113	280	12,322	6,768	673	12,093
	Percent reduction	**59%**	**22%**			**32%**			**38%**		
Year 2	DAS Qualifiers		4,700	22	7,853	5,258	19	6,569	5,117	27	6,588
	DAS Non-qualifiers		1,046	1,046	210	3,200	2,540	254	5,753	1,400	641
	Monkfish-only		387	105	1,352	902	73	1,152	1,023	105	1,352
	Bycatch fisheries		86	60	935	97	163	1,341	86	60	935
	Total		6,219	232	11,053	7,798	273	12,322	6,517	668	12,093
	Percent reduction	**59%**	**42%**			**34%**			**41%**		
Year 3	DAS Qualifiers		2,432	712	7,853	1,642	645	6,569	2,558	343	6,588
	DAS Non-qualifiers		955	955	233	3,200	2,226	343	5,753	1,235	666
	Monkfish-only		103	179	1,352	69	128	1,152	103	179	1,352
	Bycatch fisheries		85	59	935	97	154	1,341	85	59	935
	Total		3,575	945	11,053	3,868	988	12,322	3,793	1,009	12,093
	Percent reduction	**78%**	**59%**			**61%**			**60%**		

Table 3.

Estimated landings and discard mortality for vessels that **qualify** for monkfish limited access. For each alternative identified at the bottom of the page, the estimated mortality reductions have been estimated for three time periods, corresponding to when the proposed management measures would become effective in years 1, 2 and 4.

Northern Fishery Management Area

Year 1

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		416	115	708	644	1,956
Multispecies		5,606	20	6,112	3,203	21,507
Days-at-sea reduction	8%	5,135	18	5,599		19,700
Scallops		1,135	1	1,178	233	4,480
Days-at-sea reduction	26.9%	830	1	861		3,275
Combination		593	-	701	208	1,517
Days-at-sea reduction	26.9%	433	-	512		1,109
Total wo days-at-sea adjustment		7,750	136	8,699	4,080	29,460
Total with days-at-sea adjustment		6,814	134	7,680		26,040
Expected mortality reduction		**20.1%**				
Discards/Catch			1.9%			
Percent of days-at-sea used to target monkfish					13.8%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	9.6%	5,307	106	5,990	2,937	18,254
Dredges	6.7%	1,577	26	1,719	562	6,399
Gillnets	12.6%	832	4	957	782	4,743
Other	0.0%	33	-	33	6	64
Total wo days-at-sea adjustment		7,749	136	8,699	4,287	29,460

Southern Fishery Management Area

Year 1

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		1,023	105	1,352	842	1,930
Multispecies		4,658	22	5,036	2,733	14,704
Days-at-sea reduction	8%	4,267	20	4,613		13,469
Scallops		1,869	1	1,950	311	10,585
Days-at-sea reduction	26.9%	1,366	1	1,425		7,738
Combination		766	1	867	539	2,704
Days-at-sea reduction	26.9%	560	1	634		1,977
Total wo days-at-sea adjustment		8,316	129	9,205	3,886	29,923
Total with days-at-sea adjustment		7,216	127	8,024		25,113
Expected mortality reduction		**20.2%**				
Discards/Catch			1.7%			
Percent of days-at-sea used to target monkfish					13.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	10.3%	3,903	24	4,379	2,263	13,801
Dredges	7.8%	2,479	104	2,802	910	13,579
Gillnets	10.5%	229	-	256	106	177
Other	35.2%	1,138	8	1,768	1,008	2,366
Total wo days-at-sea adjustment		7,749	136	9,205	4,287	29,923

Year 2 1/2

Northern Fishery Management Area

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		284	115	708	644	1,956
Multispecies		4,867	20	6,112	3,203	21,507
Days-at-sea reduction	8%	4,458	18	5,599		19,700
Scallops		1,134	1	1,178	233	4,480
Days-at-sea reduction	26.9%	829	1	861		3,275
Combination		502	-	701	208	1,517
Days-at-sea reduction	26.9%	367	-	512		1,109
Total wo days-at-sea adjustment		6,787	136	8,699	4,080	29,460
Total with days-at-sea adjustment		5,938	134	7,680		26,040
Expected mortality reduction		**30.2%**				
Discards/Catch			2.2%			
Percent of days-at-sea used to target monkfish					13.8%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	20.3%	4,670	106	5,990	2,937	18,254
Dredges	7.0%	1,572	26	1,719	562	6,399
Gillnets	44.1%	531	4	957	782	4,743
Other	57.6%	14	-	33	6	64
Total wo days-at-sea adjustment		6,787	136	8,699	4,287	29,460

Year 2 1/2

Southern Fishery Management Area

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		387	105	1,352	842	1,930
Multispecies		3,116	22	5,036	2,733	14,704
Days-at-sea reduction	8%	2,854	20	4,613		13,469
Scallops		1,854	1	1,950	311	10,585
Days-at-sea reduction	26.9%	1,355	1	1,425		7,738
Combination		671	1	867	539	2,704
Days-at-sea reduction	26.9%	491	1	634		1,977
Total wo days-at-sea adjustment		6,028	129	9,205	3,886	29,923
Total with days-at-sea adjustment		5,087	127	8,024		25,113
Expected mortality reduction		**43.4%**				
Discards/Catch			2.4%			
Percent of days-at-sea used to target monkfish					13.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	32.5%	2,932	24	4,379	2,263	13,801
Dredges	8.2%	2,469	104	2,802	910	13,579
Gillnets	-124.2%	574	-	256	106	177
Other	96.5%	53	8	1,768	1,008	2,366
Total wo days-at-sea adjustment		6,028	136	9,205	4,287	29,923

Northern Fishery Management Area

Year 4+

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		68	243	708	-	1,956
Multispecies		1,950	1,618	6,112	-	21,507
Days-at-sea reduction	8%	1,786	1,482	5,599		19,700
Scallops		787	176	1,178	-	4,480
Days-at-sea reduction	26.9%	575	129	861		3,275
Combination		252	71	701	-	1,517
Days-at-sea reduction	26.9%	184	52	512		1,109
Total wo days-at-sea adjustment		3,057	2,108	8,699	-	29,460
Total with days-at-sea adjustment		2,614	1,906	7,680		26,040
Expected mortality reduction		**48.0%**				
Discards/Catch			42.2%			
Percent of days-at-sea used to target monkfish					0.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	40.0%	1,797	1,799	5,990	-	18,254
Dredges	23.2%	1,046	275	1,719	-	6,399
Gillnets	75.1%	209	29	957	-	4,743
Other	66.7%	5	6	33	-	64
Total wo days-at-sea adjustment		3,057	2,109	8,699	-	29,460

Southern Fishery Management Area

Year 4+

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		103	179	1,352	-	1,930
Multispecies		1,236	508	5,036	-	14,704
Days-at-sea reduction	8%	1,132	465	4,613		13,469
Scallops		1,451	221	1,950	-	10,585
Days-at-sea reduction	26.9%	1,061	162	1,425		7,738
Combination		327	117	867	-	2,704
Days-at-sea reduction	26.9%	239	86	634		1,977
Total wo days-at-sea adjustment		3,117	1,025	9,205	-	29,923
Total with days-at-sea adjustment		2,535	891	8,024		25,113
Expected mortality reduction		**62.8%**				
Discards/Catch			26.0%			
Percent of days-at-sea used to target monkfish					0.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	60.8%	1,164	552	4,379	-	13,801
Dredges	19.0%	1,808	463	2,802	-	13,579
Gillnets	92.0%	135	6	1,752	-	2,343
Other	95.2%	9	4	272	-	200
Total wo days-at-sea adjustment		3,116	1,025	9,205	-	29,923

Northern Fishery Management Area

Year 1

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		282	44	425	436	1,300
Multispecies		5,650	19	6,112	3,236	21,507
Days-at-sea reduction	8%	5,175	17	5,599		19,700
Scallops		445	20	528	233	1,551
Days-at-sea reduction	17%	371	17	440		1,292
Combination		587	-	701	252	1,517
Days-at-sea reduction	17%	489	-	584		1,264
Total wo days-at-sea adjustment		6,964	83	7,766	3,905	25,875
Total with days-at-sea adjustment		6,317	78	7,047		23,556
Expected mortality reduction		**17.7%**				
Discards/Catch			1.2%			
Percent of days-at-sea used to target monkfish					15.1%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.4%	5,223	44	5,753	2,875	17,913
Dredges	10.9%	881	35	1,028	492	3,158
Gillnets	12.5%	829	4	952	785	4,741
Other	3.0%	32	-	33	6	63
Total wo days-at-sea adjustment		6,965	83	7,766	4,158	25,875

Southern Fishery Management Area

Year 1

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		902	73	1,152	642	1,297
Multispecies		4,681	6	5,036	2,144	14,704
Days-at-sea reduction	8%	4,288	5	4,613		13,469
Scallops		566	18	666	316	2,365
Days-at-sea reduction	17%	471	15	555		1,970
Combination		761	1	867	447	2,704
Days-at-sea reduction	17%	634	1	722		2,252
Total wo days-at-sea adjustment		6,910	98	7,721	3,102	21,070
Total with days-at-sea adjustment		6,295	94	7,042		18,988
Expected mortality reduction		**17.2%**				
Discards/Catch			1.5%			
Percent of days-at-sea used to target monkfish					14.7%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.2%	3,903	7	4,258	1,628	13,458
Dredges	14.4%	1,164	90	1,465	714	5,084
Gillnets	7.2%	1,600	-	1,725	1,100	2,329
Other	10.3%	243	1	272	106	198
Total wo days-at-sea adjustment		6,910	98	7,720	3,548	21,069

Northern Fishery Management Area

Year 2

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		282	44	425	436	1,300
Multispecies		5,650	19	6,112	3,236	21,507
Days-at-sea reduction	8.4%	5,175	17	5,599		19,700
Scallops		445	20	528	233	1,551
Days-at-sea reduction	26.9%	325	15	386		1,134
Combination		587	-	701	252	1,517
Days-at-sea reduction	26.9%	429	-	512		1,109
Total wo days-at-sea adjustment		6,964	83	7,766	3,905	25,875
Total with days-at-sea adjustment		6,212	76	6,922		23,243
Expected mortality reduction		**19.0%**				
Discards/Catch			1.2%			
Percent of days-at-sea used to target monkfish					15.1%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.4%	5,223	44	5,753	2,875	17,913
Dredges	10.9%	881	35	1,028	492	3,158
Gillnets	12.5%	829	4	952	785	4,741
Other	3.0%	32	-	33	6	63
Total wo days-at-sea adjustment		6,965	83	7,766	4,158	25,875

Southern Fishery Management Area

Year 2

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		902	73	1,152	642	1,297
Multispecies		4,681	6	5,036	2,144	14,704
Days-at-sea reduction	8%	4,288	5	4,613		13,469
Scallops		566	18	666	316	2,365
Days-at-sea reduction	26.9%	414	13	487		1,729
Combination		761	1	867	447	2,704
Days-at-sea reduction	26.9%	556	1	634		1,977
Total wo days-at-sea adjustment		6,910	98	7,721	3,102	21,070
Total with days-at-sea adjustment		6,160	92	6,886		18,471
Expected mortality reduction		**19.0%**				
Discards/Catch			1.5%			
Percent of days-at-sea used to target monkfish					14.7%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.2%	3,903	7	4,258	1,628	13,458
Dredges	14.4%	1,164	90	1,465	714	5,084
Gillnets	7.2%	1,600	-	1,725	1,100	2,329
Other	10.3%	243	1	272	106	198
Total wo days-at-sea adjustment		6,910	98	7,720	3,548	21,069

Northern Fishery Management Area

Year 4+

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		32	111	425	-	1,300
Multispecies		1,950	1,618	6,112	-	21,507
Days-at-sea reduction	8%	1,786	1,482	5,599		19,700
Scallops		283	102	528	-	1,551
Days-at-sea reduction	26.9%	207	75	386		1,134
Combination		252	71	701	-	1,517
Days-at-sea reduction	26.9%	184	52	512		1,109
Total wo days-at-sea adjustment		2,517	1,902	7,766	-	25,875
Total with days-at-sea adjustment		2,209	1,720	6,922		23,243
Expected mortality reduction		**49.4%**				
Discards/Catch			43.8%			
Percent of days-at-sea used to target monkfish					0.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	40.0%	1,764	1,690	5,753	-	17,913
Dredges	30.3%	540	177	1,028	-	3,158
Gillnets	75.0%	209	29	952	-	4,741
Other	66.7%	5	6	33	-	63
Total wo days-at-sea adjustment		2,518	1,902	7,766	-	25,875

Southern Fishery Management Area

Year 4+

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		69	128	1,152	-	1,297
Multispecies		1,236	508	5,036	-	14,704
Days-at-sea reduction	8%	1,132	465	4,613		13,469
Scallops		370	129	666	-	2,365
Days-at-sea reduction	26.9%	270	94	487		1,729
Combination		327	117	867	-	2,704
Days-at-sea reduction	26.9%	239	86	634		1,977
Total wo days-at-sea adjustment		2,002	882	7,721	-	21,070
Total with days-at-sea adjustment		1,711	773	6,886		18,471
Expected mortality reduction		**67.8%**				
Discards/Catch			31.1%			
Percent of days-at-sea used to target monkfish					0.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	60.5%	1,134	546	4,258	-	13,458
Dredges	28.4%	725	324	1,465	-	5,084
Gillnets	91.9%	134	6	1,725	-	2,329
Other	95.6%	9	3	272	-	198
Total wo days-at-sea adjustment		2,002	879	7,720	-	21,069

Northern Fishery Management Area

Year 1

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		416	115	708	644	1,956
Multispecies		4,361	16	4,684	2,624	16,156
Days-at-sea reduction	8%	3,995	15	4,291		14,799
Scallops		1,056	42	1,178	483	4,480
Days-at-sea reduction	17%	880	35	981		3,732
Combination		556	-	670	217	1,382
Days-at-sea reduction	17%	463	-	558		1,151
Total wo days-at-sea adjustment		6,389	173	7,240	3,751	23,974
Total with days-at-sea adjustment		5,753	165	6,538		21,638
Expected mortality reduction		**18.3%**				
Discards/Catch			2.8%			
Percent of days-at-sea used to target monkfish					15.6%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.7%	4,128	102	4,634	2,394	13,186
Dredges	9.3%	1,465	67	1,690	797	6,280
Gillnets	13.0%	767	4	886	772	4,491
Other	0.0%	30	-	30	5	18
Total wo days-at-sea adjustment		6,390	173	7,240	3,968	23,975

Southern Fishery Management Area

Year 1

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		1,023	105	1,352	842	1,930
Multispecies		3,620	5	3,873	1,719	9,417
Days-at-sea reduction	8%	3,316	5	3,548		8,626
Scallops		1,805	30	1,950	705	10,585
Days-at-sea reduction	17%	1,504	25	1,624		8,817
Combination		659	1	765	354	2,114
Days-at-sea reduction	17%	549	1	637		1,761
Total wo days-at-sea adjustment		7,107	141	7,940	3,266	24,046
Total with days-at-sea adjustment		6,391	135	7,161		21,134
Expected mortality reduction		**17.8%**				
Discards/Catch			2.1%			
Percent of days-at-sea used to target monkfish					13.6%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.7%	2,920	6	3,206	1,237	8,387
Dredges	9.4%	2,360	133	2,752	1,185	13,149
Gillnets	7.5%	1,582	-	1,710	1,093	2,318
Other	9.9%	244	1	272	105	192
Total wo days-at-sea adjustment		7,106	140	7,940	3,620	24,046

Northern Fishery Management Area

Year 2

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		416	115	708	644	1,956
Multispecies		4,361	16	4,684	2,624	16,156
Days-at-sea reduction	8%	3,995	15	4,291		14,799
Scallops		1,056	42	1,178	483	4,480
Days-at-sea reduction	26.9%	772	31	861		3,275
Combination		556	-	670	217	1,382
Days-at-sea reduction	26.9%	406	-	490		1,010
Total wo days-at-sea adjustment		6,389	173	7,240	3,751	23,974
Total with days-at-sea adjustment		5,589	160	6,349		21,040
Expected mortality reduction		**20.6%**				
Discards/Catch			2.8%			
Percent of days-at-sea used to target monkfish					15.6%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.7%	4,128	102	4,634	2,394	13,186
Dredges	9.3%	1,465	67	1,690	797	6,280
Gillnets	13.0%	767	4	886	772	4,491
Other	0.0%	30	-	30	5	18
Total wo days-at-sea adjustment		6,390	173	7,240	3,968	23,975

Southern Fishery Management Area

Year 2

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		1,023	105	1,352	842	1,930
Multispecies		3,620	5	3,873	1,719	9,417
Days-at-sea reduction	8%	3,316	5	3,548		8,626
Scallops		1,805	30	1,950	705	10,585
Days-at-sea reduction	26.9%	1,319	22	1,425		7,738
Combination		659	1	765	354	2,114
Days-at-sea reduction	26.9%	482	1	559		1,545
Total wo days-at-sea adjustment		7,107	141	7,940	3,266	24,046
Total with days-at-sea adjustment		6,140	132	6,884		19,839
Expected mortality reduction		**21.0%**				
Discards/Catch			2.1%			
Percent of days-at-sea used to target monkfish					13.6%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	8.7%	2,920	6	3,206	1,237	8,387
Dredges	9.4%	2,360	133	2,752	1,185	13,149
Gillnets	7.5%	1,582	-	1,710	1,093	2,318
Other	9.9%	244	1	272	105	192
Total wo days-at-sea adjustment		7,106	140	7,940	3,620	24,046

Northern Fishery Management Area

Year 4+

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		68	243	708	-	1,956
Multispecies		2,188	847	4,648	-	16,156
Days-at-sea reduction	8%	2,004	776	4,258		14,799
Scallops		914	85	1,178	-	4,480
Days-at-sea reduction	26.9%	668	62	861		3,275
Combination		287	41	670	-	1,382
Days-at-sea reduction	26.9%	210	30	490		1,010
Total wo days-at-sea adjustment		3,457	1,216	7,204	-	23,974
Total with days-at-sea adjustment		2,950	1,111	6,316		21,040
Expected mortality reduction		**43.6%**				
Discards/Catch			27.4%			
Percent of days-at-sea used to target monkfish					0.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	35.2%	1,966	1,035	4,634	-	13,186
Dredges	20.1%	1,193	158	1,690	-	6,280
Gillnets	64.8%	295	17	886	-	4,491
Other	70.0%	3	6	30	-	18
Total wo days-at-sea adjustment		3,457	1,216	7,240	-	23,975

Southern Fishery Management Area

Year 4+

Permit type	Percent adjustment due to days-at-sea allocations	Expected Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Monkfish-only		103	179	1,352	-	1,930
Multispecies		1,236	248	3,873	-	9,417
Days-at-sea reduction	8%	1,132	227	3,548		8,626
Scallops		1,610	100	1,950	-	10,585
Days-at-sea reduction	26.9%	1,177	73	1,425		7,738
Combination		340	59	765	-	2,114
Days-at-sea reduction	26.9%	249	43	559		1,545
Total wo days-at-sea adjustment		3,289	586	7,940	-	24,046
Total with days-at-sea adjustment		2,661	522	6,884		19,839
Expected mortality reduction		**59.9%**				
Discards/Catch			16.4%			
Percent of days-at-sea used to target monkfish					0.0%	

	Percent reduction in monkfish mortality	Landings	Discard mortality	1995-1996 Landings	Monkfish days-at-sea used for trips over bycatch trip limit	1995-1996 days absent when monkfish > 0 lbs.
Trawls	60.0%	1,008	275	3,206	-	8,387
Dredges	17.1%	1,978	303	2,752	-	13,149
Gillnets	82.7%	290	5	1,710	-	2,318
Other	94.1%	14	2	272	-	192
Total wo days-at-sea adjustment		3,290	585	7,940	-	24,046

Table 4.

Estimated landings and discard mortality for vessels that **do not qualify** for monkfish limited access. For each alternative identified at the bottom of the page, the estimated mortality reductions have been estimated for three time periods, corresponding to when the proposed management measures would become effective in years 1, 2 and 4.

Northern Fishery Management Area

Year 1

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11		11	0%
Other gillnet	69.2%	64	6	227	9%
Other	62.9%	29	27	151	48%
Total for vessels without days-at-sea	64.8%	104	33	389	24.1%
Grondfish trawl	47.2%	86	9	180	9%
Flatfish trawl	44.7%	164	8	311	5%
Summer flounder trawl	77.8%	1	1	9	50%
Squid/Whiting/Scup trawl	18.2%	8	1	11	11%
Other trawl	85.3%	26	3	197	10%
Scalop dredge	29.4%	114	1	163	1%
Scallop trawl	25.0%	3	-	4	0%
Other dredge	97.9%	1	-	47	0%
Groundfish gillnet	58.8%	218	22	583	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	20.0%	12	4	20	25%
Total for vessels with days-at-sea		706	49	1,599	6.5%
Total for vessels that do not qualify for monkfish limited access	**55.1%**	810	82	1,988	9.2%

Southern Fishery Management Area

Year 1

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	25.0%	7	17	32	
Squid/Whiting/Scup trawl	20.7%	9	14	29	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	39	5	651	11%
Other	76.4%	28	24	220	46%
Total for vessels without days-at-se	84.4%	86	60	935	41.1%
Grondfish trawl	46.9%	15	2	32	12%
Flatfish trawl	52.6%	26	10	76	28%
Summer flounder trawl	56.9%	64	20	195	24%
Squid/Whiting/Scup trawl	19.7%	97	127	279	57%
Other trawl	86.6%	23	22	337	49%
Scalop dredge	30.0%	660	22	974	3%
Scallop trawl	31.0%	98	2	145	2%
Other dredge	92.7%	2	1	41	33%
Groundfish gillnet	93.2%	70	3	1,067	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	14.3%	4	2	7	33%
Total for vessels with days-at-sea		1,104	212	3,200	16.1%
Total for vessels that do not qualify for monkfish limited access	**64.6%**	1,190	272	4,135	18.6%

Year 2

Northern Fishery Management Area

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11		11	0%
Other gillnet	69.2%	64	6	227	9%
Other	62.9%	29	27	151	48%
Total for vessels without days-at-sea	64.8%	104	33	389	24.1%
Grondfish trawl	47.2%	86	9	180	9%
Flatfish trawl	44.7%	164	8	311	5%
Summer flounder trawl	77.8%	1	1	9	50%
Squid/Whiting/Scup trawl	18.2%	8	1	11	11%
Other trawl	85.3%	26	3	197	10%
Scalop dredge	35.0%	105	1	163	1%
Scallop trawl	25.0%	3	-	4	0%
Other dredge	97.9%	1	-	47	0%
Groundfish gillnet	58.8%	218	22	583	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	20.0%	12	4	20	25%
Total for vessels with days-at-sea		697	49	1,599	6.6%
Total for vessels that do not qualify for monkfish limited access	**55.6%**	801	82	1,988	9.3%

Year 2

Southern Fishery Management Area

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	25.0%	7	17	32	
Squid/Whiting/Scup trawl	20.7%	9	14	29	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	39	5	651	11%
Other	76.4%	28	24	220	46%
Total for vessels without days-at-se	84.4%	86	60	935	41.1%
Grondfish trawl	46.9%	15	2	32	12%
Flatfish trawl	52.6%	26	10	76	28%
Summer flounder trawl	56.9%	64	20	195	24%
Squid/Whiting/Scup trawl	19.7%	97	127	279	57%
Other trawl	86.6%	23	22	337	49%
Scalop dredge	35.4%	609	20	974	3%
Scallop trawl	35.9%	91	2	145	2%
Other dredge	92.7%	2	1	41	33%
Groundfish gillnet	93.2%	70	3	1,067	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	14.3%	4	2	7	33%
Total for vessels with days-at-sea		1,046	210	3,200	16.7%
Total for vessels that do not qualify for monkfish limited access	**66.1%**	1,132	270	4,135	19.3%

Northern Fishery Management Area

Year 4+

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11		11	0%
Other gillnet	69.2%	64	6	227	9%
Other	62.9%	29	27	151	48%
Total for vessels without days-at-sea	64.8%	104	33	389	24.1%
Grondfish trawl	48.9%	80	12	180	13%
Flatfish trawl	47.9%	146	16	311	10%
Summer flounder trawl	77.8%	1	1	9	50%
Squid/Whiting/Scup trawl	18.2%	8	1	11	11%
Other trawl	85.3%	26	3	197	10%
Scalop dredge	41.1%	87	9	163	9%
Scallop trawl	25.0%	3	-	4	0%
Other dredge	97.9%	1	-	47	0%
Groundfish gillnet	58.8%	218	22	583	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	15.0%	13	4	20	24%
Total for vessels with days-at-sea		656	68	1,599	9.4%
Total for vessels that do not qualify for monkfish limited access	**56.7%**	760	101	1,988	11.7%

Southern Fishery Management Area

Year 4+

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	25.0%	7	17	32	
Squid/Whiting/Scup trawl	20.7%	9	14	29	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	39	5	651	11%
Other	77.3%	27	23	220	46%
Total for vessels without days-at-se	84.6%	85	59	935	41.0%
Grondfish trawl	46.9%	15	2	32	12%
Flatfish trawl	52.6%	26	10	76	28%
Summer flounder trawl	56.9%	64	20	195	24%
Squid/Whiting/Scup trawl	19.7%	97	127	279	57%
Other trawl	86.6%	23	22	337	49%
Scalop dredge	41.3%	532	40	974	7%
Scallop trawl	43.4%	77	5	145	6%
Other dredge	92.7%	2	1	41	33%
Groundfish gillnet	93.2%	70	3	1,067	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	14.3%	4	2	7	33%
Total for vessels with days-at-sea		955	233	3,200	19.6%
Total for vessels that do not qualify for monkfish limited access	**67.8%**	1,040	292	4,135	21.9%

Year 1

Northern Fishery Management Area

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11	-	11	0%
Other gillnet	70.5%	64	6	237	9%
Other	63.0%	94	166	702	64%
Total for vessels without days-at-sea	64.1%	169	172	950	50.4%
Grondfish trawl	49.0%	103	20	241	16%
Flatfish trawl	47.9%	146	16	311	10%
Summer flounder trawl	81.8%	1	1	11	50%
Squid/Whiting/Scup trawl	8.3%	9	2	12	18%
Other trawl	85.6%	26	3	202	10%
Scalop dredge	32.2%	843	70	1,346	8%
Scallop trawl	25.0%	3	-	4	0%
Other dredge	98.2%	2	-	110	0%
Groundfish gillnet	58.8%	218	22	583	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	5.3%	13	5	19	28%
Total for vessels with days-at-sea		1,437	139	2,913	8.8%
Total for vessels that do not qualify for monkfish limited access	**50.4%**	1,606	311	3,863	16.2%

Year 1

Southern Fishery Management Area

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	29.7%	9	17	37	
Squid/Whiting/Scup trawl	23.3%	9	14	30	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	43	5	706	10%
Other	69.9%	34	136	565	80%
Total for vessels without days-at-se	79.9%	98	172	1,341	63.7%
Grondfish trawl	48.5%	15	2	33	12%
Flatfish trawl	52.6%	26	10	76	28%
Summer flounder trawl	57.0%	78	26	242	25%
Squid/Whiting/Scup trawl	20.3%	99	132	290	57%
Other trawl	88.2%	24	23	398	49%
Scalop dredge	30.2%	2,238	57	3,287	2%
Scallop trawl	30.4%	117	2	171	2%
Other dredge	95.6%	5	1	135	17%
Groundfish gillnet	93.2%	70	3	1,067	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	28.6%	3	2	7	40%
Total for vessels with days-at-sea		2,720	259	5,753	8.7%
Total for vessels that do not qualify for monkfish limited access	**54.2%**	2,818	431	7,094	13.3%

Northern Fishery Management Area

Year 2

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11	-	11	0%
Other gillnet	70.5%	64	6	237	9%
Other	63.5%	94	162	702	63%
Total for vessels without days-at-sea	64.5%	169	168	950	49.9%
Grondfish trawl	49.0%	103	20	241	16%
Flatfish trawl	47.9%	146	16	311	10%
Summer flounder trawl	81.8%	1	1	11	50%
Squid/Whiting/Scup trawl	8.3%	9	2	12	18%
Other trawl	85.6%	26	3	202	10%
Scalop dredge	37.3%	779	65	1,346	8%
Scallop trawl	25.0%	3	-	4	0%
Other dredge	98.2%	2	-	110	0%
Groundfish gillnet	58.8%	218	22	583	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	15.8%	12	4	19	25%
Total for vessels with days-at-sea		1,372	133	2,913	8.8%
Total for vessels that do not qualify for monkfish limited access	**52.3%**	1,541	301	3,863	16.3%

Southern Fishery Management Area

Year 2

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	29.7%	9	17	37	
Squid/Whiting/Scup trawl	23.3%	9	14	30	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	43	5	706	10%
Other	71.7%	33	127	565	79%
Total for vessels without days-at-se	80.6%	97	163	1,341	62.7%
Grondfish trawl	48.5%	15	2	33	12%
Flatfish trawl	52.6%	26	10	76	28%
Summer flounder trawl	57.0%	78	26	242	25%
Squid/Whiting/Scup trawl	20.3%	99	132	290	57%
Other trawl	88.2%	24	23	398	49%
Scalop dredge	35.5%	2,066	53	3,287	3%
Scallop trawl	35.7%	108	2	171	2%
Other dredge	95.6%	5	1	135	17%
Groundfish gillnet	93.2%	70	3	1,067	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	28.6%	4	1	7	20%
Total for vessels with days-at-sea		2,540	254	5,753	9.1%
Total for vessels that do not qualify for monkfish limited access	**56.9%**	2,637	417	7,094	13.7%

Northern Fishery Management Area

Year 4+

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11	-	11	0%
Other gillnet	70.5%	64	6	237	9%
Other	64.1%	93	159	702	63%
Total for vessels without days-at-sea	64.9%	168	165	950	49.5%
Grondfish trawl	49.0%	103	20	241	16%
Flatfish trawl	47.9%	146	16	311	10%
Summer flounder trawl	81.8%	1	1	11	50%
Squid/Whiting/Scup trawl	8.3%	9	2	12	18%
Other trawl	85.6%	26	3	202	10%
Scalop dredge	44.6%	619	127	1,346	17%
Scallop trawl	25.0%	3	-	4	0%
Other dredge	98.2%	2	-	110	0%
Groundfish gillnet	58.8%	218	22	583	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	15.8%	12	4	19	25%
Total for vessels with days-at-sea		1,212	195	2,913	13.9%
Total for vessels that do not qualify for monkfish limited access	**55.0%**	1,380	360	3,863	20.7%

Southern Fishery Management Area

Year 4+

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	29.7%	9	17	37	
Squid/Whiting/Scup trawl	23.3%	9	14	30	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	43	5	706	10%
Other	73.3%	33	118	565	78%
Total for vessels without days-at-se	81.3%	97	154	1,341	61.4%
Grondfish trawl	48.5%	15	2	33	12%
Flatfish trawl	52.6%	26	10	76	28%
Summer flounder trawl	57.0%	78	26	242	25%
Squid/Whiting/Scup trawl	20.3%	99	132	290	57%
Other trawl	88.2%	24	23	398	49%
Scalop dredge	42.0%	1,770	137	3,287	7%
Scallop trawl	43.3%	91	6	171	6%
Other dredge	95.6%	5	1	135	17%
Groundfish gillnet	93.2%	70	3	1,067	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	28.6%	3	2	7	40%
Total for vessels with days-at-sea		2,226	343	5,753	13.4%
Total for vessels that do not qualify for monkfish limited access	**60.2%**	2,323	497	7,094	17.6%

Northern Fishery Management Area

Year 1

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11	-	11	0%
Other gillnet	69.2%	64	6	227	9%
Other	62.9%	29	27	151	48%
Total for vessels without days-at-sea	64.8%	104	33	389	24.1%
Grondfish trawl	48.4%	449	114	1,091	20%
Flatfish trawl	48.6%	570	120	1,342	17%
Summer flounder trawl	78.7%	2	11	61	85%
Squid/Whiting/Scup trawl	15.8%	11	5	19	31%
Other trawl	86.9%	42	103	1,104	71%
Scalop dredge	30.0%	142	3	207	2%
Scallop trawl	27.3%	7	1	11	13%
Other dredge	98.6%	1	-	70	0%
Groundfish gillnet	61.8%	256	25	736	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	11.1%	18	6	27	25%
Total for vessels with days-at-sea		1,571	388	4,742	19.8%
Total for vessels that do not qualify for monkfish limited access	**59.8%**	1,675	388	5,131	18.8%

Southern Fishery Management Area

Year 1

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	59.4%	7	6	32	
Squid/Whiting/Scup trawl	20.7%	9	14	29	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	39	5	651	11%
Other	71.4%	28	35	220	56%
Total for vessels without days-at-se	84.4%	86	60	935	41.1%
Grondfish trawl	54.8%	51	63	252	55%
Flatfish trawl	57.0%	73	127	465	64%
Summer flounder trawl	62.8%	117	64	486	35%
Squid/Whiting/Scup trawl	21.7%	168	297	594	64%
Other trawl	92.2%	42	55	1,238	57%
Scalop dredge	30.0%	715	24	1,056	3%
Scallop trawl	30.4%	110	2	161	2%
Other dredge	93.9%	2	1	49	33%
Groundfish gillnet	93.3%	73	3	1,141	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	37.5%	4	6	16	60%
Total for vessels with days-at-sea		1,400	643	5,505	31.5%
Total for vessels that do not qualify for monkfish limited access	**66.0%**	1,486	703	6,440	32.1%

Northern Fishery Management Area

Year 2

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11	-	11	0%
Other gillnet	69.2%	64	6	227	9%
Other	62.9%	29	27	151	48%
Total for vessels without days-at-sea	64.8%	104	33	389	24.1%
Grondfish trawl	49.1%	436	119	1,091	21%
Flatfish trawl	50.0%	528	143	1,342	21%
Summer flounder trawl	78.7%	2	11	61	85%
Squid/Whiting/Scup trawl	15.8%	11	5	19	31%
Other trawl	86.9%	42	103	1,104	71%
Scalop dredge	30.0%	142	3	207	2%
Scallop trawl	27.3%	7	1	11	13%
Other dredge	98.6%	1	-	70	0%
Groundfish gillnet	61.8%	256	25	736	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	11.1%	18	6	27	25%
Total for vessels with days-at-sea		1,516	416	4,742	21.5%
Total for vessels that do not qualify for monkfish limited access	**59.7%**	1,620	449	5,131	21.7%

Southern Fishery Management Area

Year 2

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	59.4%	7	6	32	
Squid/Whiting/Scup trawl	20.7%	9	14	29	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	39	5	651	11%
Other	71.4%	28	35	220	56%
Total for vessels without days-at-se	84.4%	86	60	935	41.1%
Grondfish trawl	54.8%	51	63	252	55%
Flatfish trawl	57.0%	73	127	465	64%
Summer flounder trawl	62.8%	117	64	486	35%
Squid/Whiting/Scup trawl	21.7%	168	297	594	64%
Other trawl	92.2%	42	55	1,238	57%
Scalop dredge	30.2%	715	22	1,056	3%
Scallop trawl	30.4%	110	2	161	2%
Other dredge	93.9%	2	1	49	33%
Groundfish gillnet	93.3%	73	3	1,141	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	37.5%	4	6	16	60%
Total for vessels with days-at-sea		1,400	641	5,505	31.4%
Total for vessels that do not qualify for monkfish limited access	**66.0%**	1,486	701	6,440	32.1%

Northern Fishery Management Area

Year 4+

Permit type	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl		-		-	
Squid/Whiting/Scup trawl		-		-	
Dogfish gillnet	0.0%	11	-	11	0%
Other gillnet	69.2%	64	6	227	9%
Other	62.9%	29	27	151	48%
Total for vessels without days-at-sea	64.8%	104	33	389	24.1%
Grondfish trawl	49.1%	436	119	1,091	21%
Flatfish trawl	50.0%	528	143	1,342	21%
Summer flounder trawl	78.7%	2	11	61	85%
Squid/Whiting/Scup trawl	15.8%	11	5	19	31%
Other trawl	86.9%	42	103	1,104	71%
Scalop dredge	41.5%	109	12	207	10%
Scallop trawl	45.5%	5	1	11	17%
Other dredge	98.6%	1	-	70	0%
Groundfish gillnet	61.8%	256	25	736	9%
Dogfish gillnet	1.4%	73	-	74	0%
Other	11.1%	18	6	27	25%
Total for vessels with days-at-sea		1,481	425	4,742	22.3%
Total for vessels that do not qualify for monkfish limited access	**60.2%**	1,585	458	5,131	22.4%

Southern Fishery Management Area

Year 4+

	Percent reduction in monkfish mortality	Landings (mt)	Discard mortality (mt)	1995-1996 Landings (mt)	Proportion of catch discarded
Summer flounder trawl	59.4%	7	6	32	
Squid/Whiting/Scup trawl	20.7%	9	14	29	
Dogfish gillnet	0.0%	3	-	3	0%
Other gillnet	93.2%	39	5	651	11%
Other	72.3%	27	34	220	56%
Total for vessels without days-at-se	84.6%	85	59	935	41.0%
Grondfish trawl	54.8%	51	63	252	55%
Flatfish trawl	57.0%	73	127	465	64%
Summer flounder trawl	62.8%	117	64	486	35%
Squid/Whiting/Scup trawl	21.7%	168	297	594	64%
Other trawl	92.2%	42	55	1,238	57%
Scalop dredge	41.4%	575	44	1,056	7%
Scallop trawl	42.9%	86	6	161	7%
Other dredge	93.9%	2	1	49	33%
Groundfish gillnet	93.3%	73	3	1,141	4%
Dogfish gillnet	2.1%	45	1	47	2%
Other	50.0%	3	5	16	63%
Total for vessels with days-at-sea		1,235	666	5,505	35.0%
Total for vessels that do not qualify for monkfish limited access	**68.2%**	1,320	725	6,440	35.5%

APPENDIX III

SUMMARY OF GEAR SELECTIVELY RESEARCH FOR MONKFISH

New England Fishery Management Council
5 Broadway, Saugus, Massachusetts 01906
(617) 231-0422 FTS 565-8457

Chairman
Joseph M. Brancaleone

Executive Director
Douglas G. Marshall

DATE: December 5, 1995

TO: Monkfish Oversight Committee

FROM: Andrew Applegate aja

SUBJECT: Gear selectivity research for monkfish

I recently obtained the preliminary results of a selective grate undergoing research in France. Several designs, similar in configuration to the Nordmore grate, have been evaluated. The purpose of this research is to determine if gear technology can be more effective in reducing discards of sub-legal finfish in a fishery targeting demersal non-gadid (cod-like) species where there are minimum size regulations. The primary target species is monkfish.

This research is being conducted at Ifremer, Station de Lorient by several researchers including M. Meillat, H. DuPouy, G. Bavouzet, B. Kergoat, F. Morandeau, O. Gaudou, J.P. Vacherot, and J.P. George. The following results and gear design are entirely attributable to the authors. Some of the information below has been summarized from personal communications with one of the researchers.

The commercial bottom fishery in the region of interest targets monkfish, rays, megrim (flatfish), and hake. Monkfish are the primary target finfish and range from 15 to 150 cm (6 to 60 in) total length. Two species of monkfish are caught, Lophius piscatorius and L. budegassa. Both grow at similar or slightly faster rates than our monkfish, L. americanus. L. budegassa does not grow as large as L. piscatorius. The legal minimum size for these species is 30 cm (11.8 in) total length. The rays are second in importance and range from 10 to 90 cm total length. Flatfish are third in importance and range from 10 to 60 cm total length. Hakes are the primary gadid species targeted by the fishery.

The research gear design is basically a double cod end design, with the experimental grate deflecting large fish into the upper cod end. The cod end was made of 70 mm (2¾ in) mesh. The frame for the grate was 80 by 120 cm (31½ x 47 in) and was located within the extension/lengthener. The net was 33.6 m (110 ft) wide and was towed in 100 to 150 m (55 - 82 fm) at three knots for two to two and a half hours.

Five trial designs were made, three with vertical bars only, two with a grill (vertical and horizontal bars) design. The vertical bar grilles were spaced at 40, 55, and 77.5 mm (1.6, 2.2, and 3.1 in). The two grille designs were 110 by 65 mm (4.3 x 2.6 in) and 110 by 50 mm (4.3 x 2 in). It appears that the latter design proved the most selective for the size and type of fish encountered, the fishing conditions, and their minimum sizes. The Ifremer researchers estimated their short term loss due to escapement of legal size fish through the grille. They also estimated their long term gain, based on the growth rates of discarded fish that would escape through the grille. Overall, they estimated the decrease in landings would be recovered within three years.

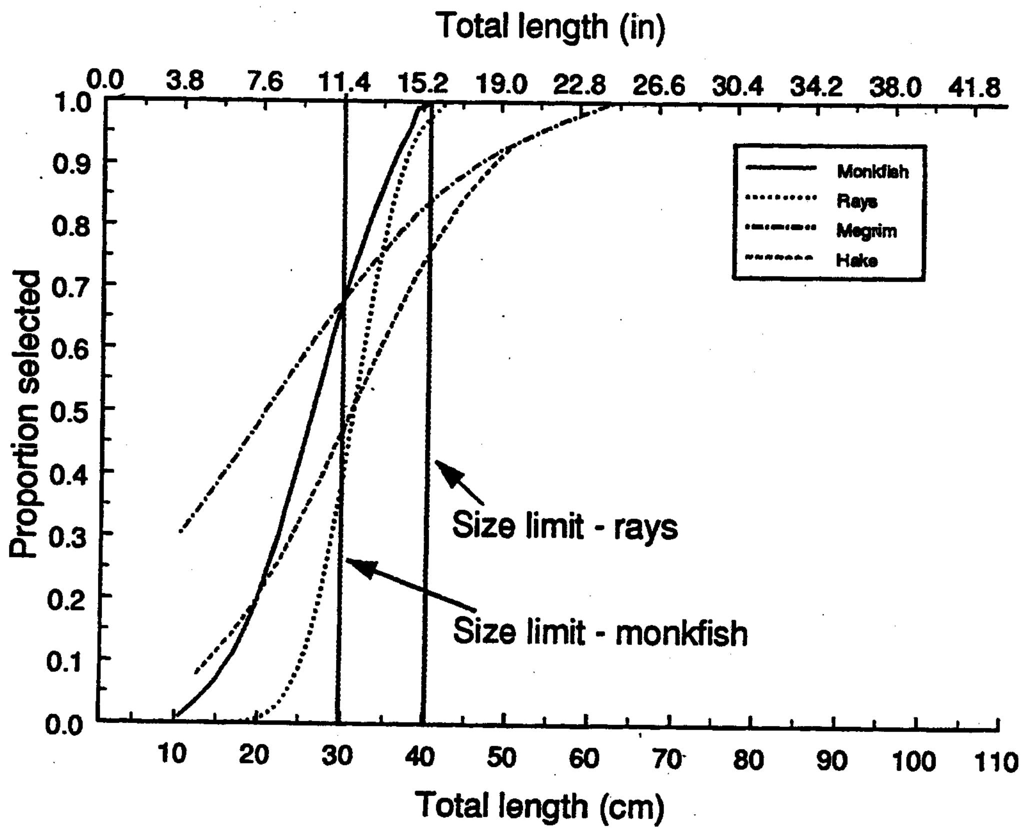
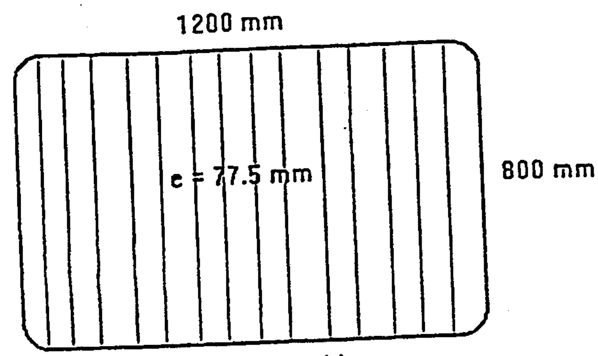


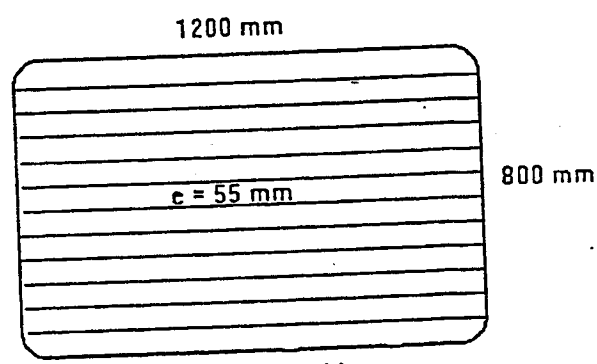
Figure 1. Selectivity of 110 x 65 mm grille for various species in the Celtic Sea and the Bay of Biscay. From Meillat et al. 1995.

The selectivity of the optimum grille for the various species is shown in Figure 1. The L_{50} for monkfish is about 26 cm, somewhat below their minimum size limit. I have also included several figures from their publications showing the gear design and how it is meant to operate. Another of their graphs shows the selectivity of the 110 x 50 mm grille for monkfish at length. The selectivity of sub-legal and legal monkfish for all five of their evaluations is shown in Table 1.

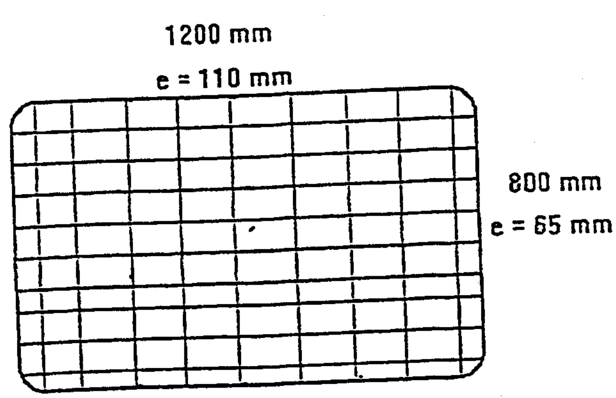
Appendix 4: Different grids tested with the selective trawl



Vertical bars grid



Horizontal bars grid



Horizontal and vertical bars grid

POSITIONNEMENT DU CAPTEUR SCANMAR SUR LA GRILLE SELECTIVE

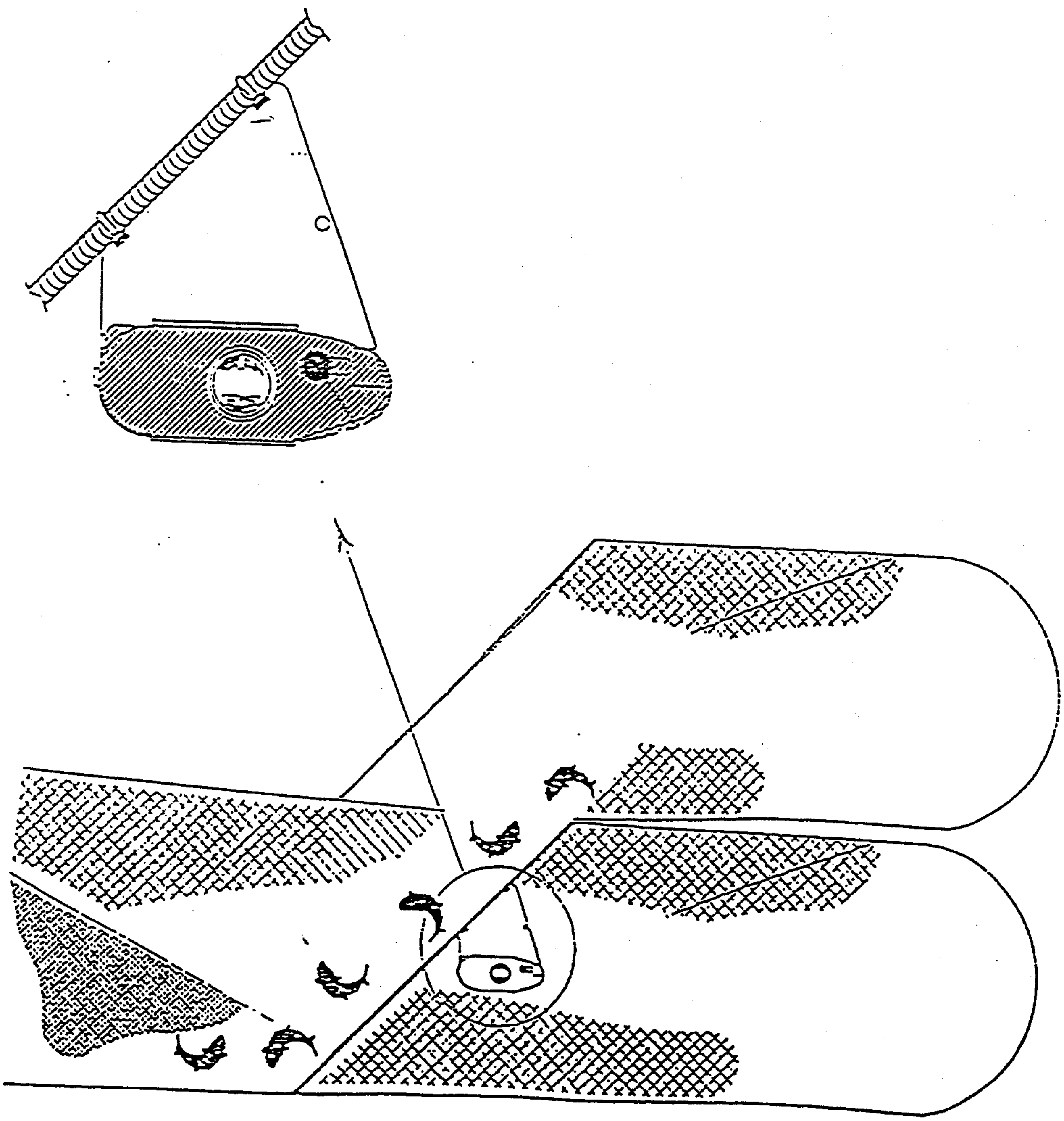


Figure 2 - Représentation du capteur SCANMAR par rapport à la grille.

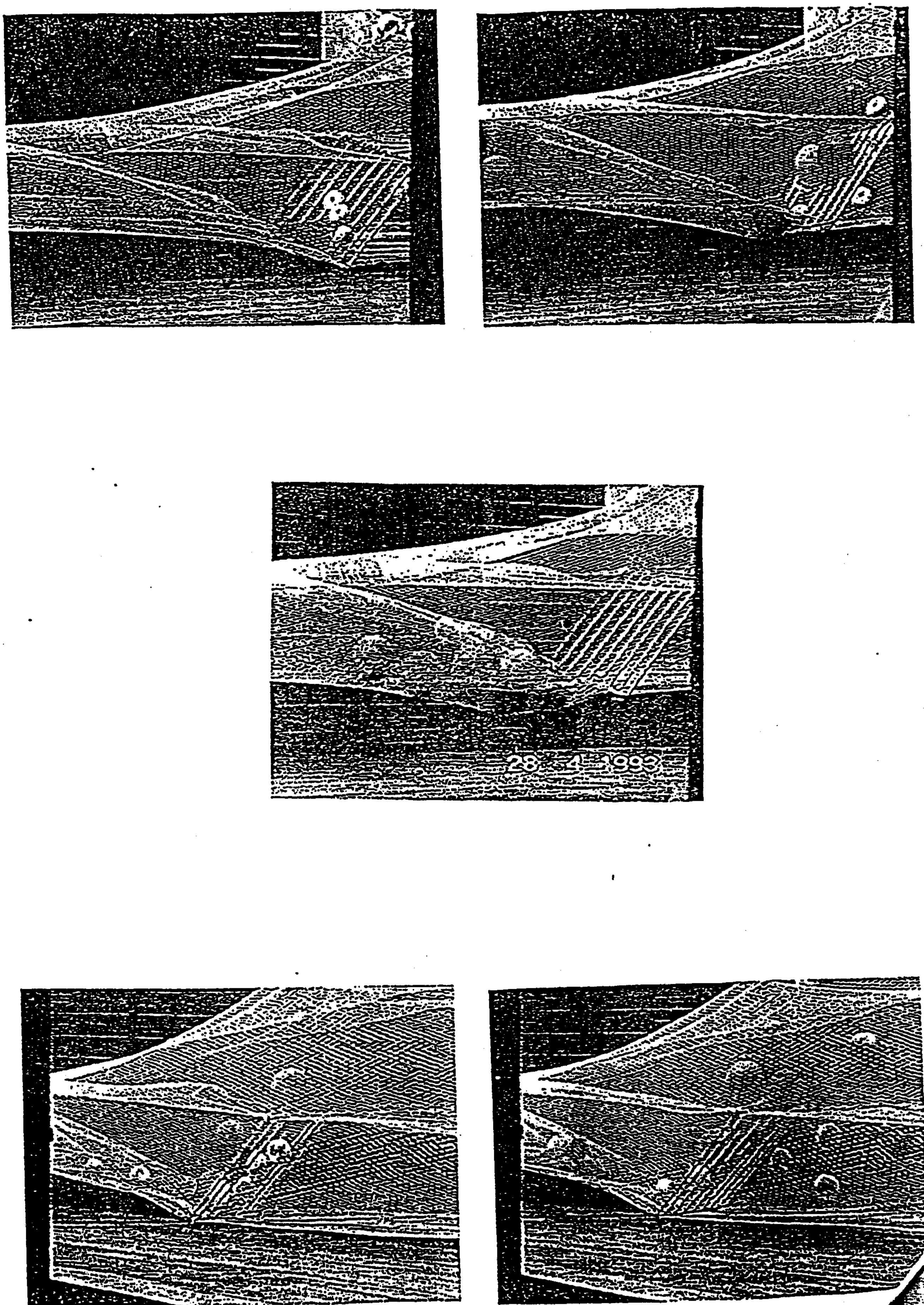


Figure 3: Views of the model of the selective trawl showing the grid and the lengthener before it. The smaller balls simulate the escapees.

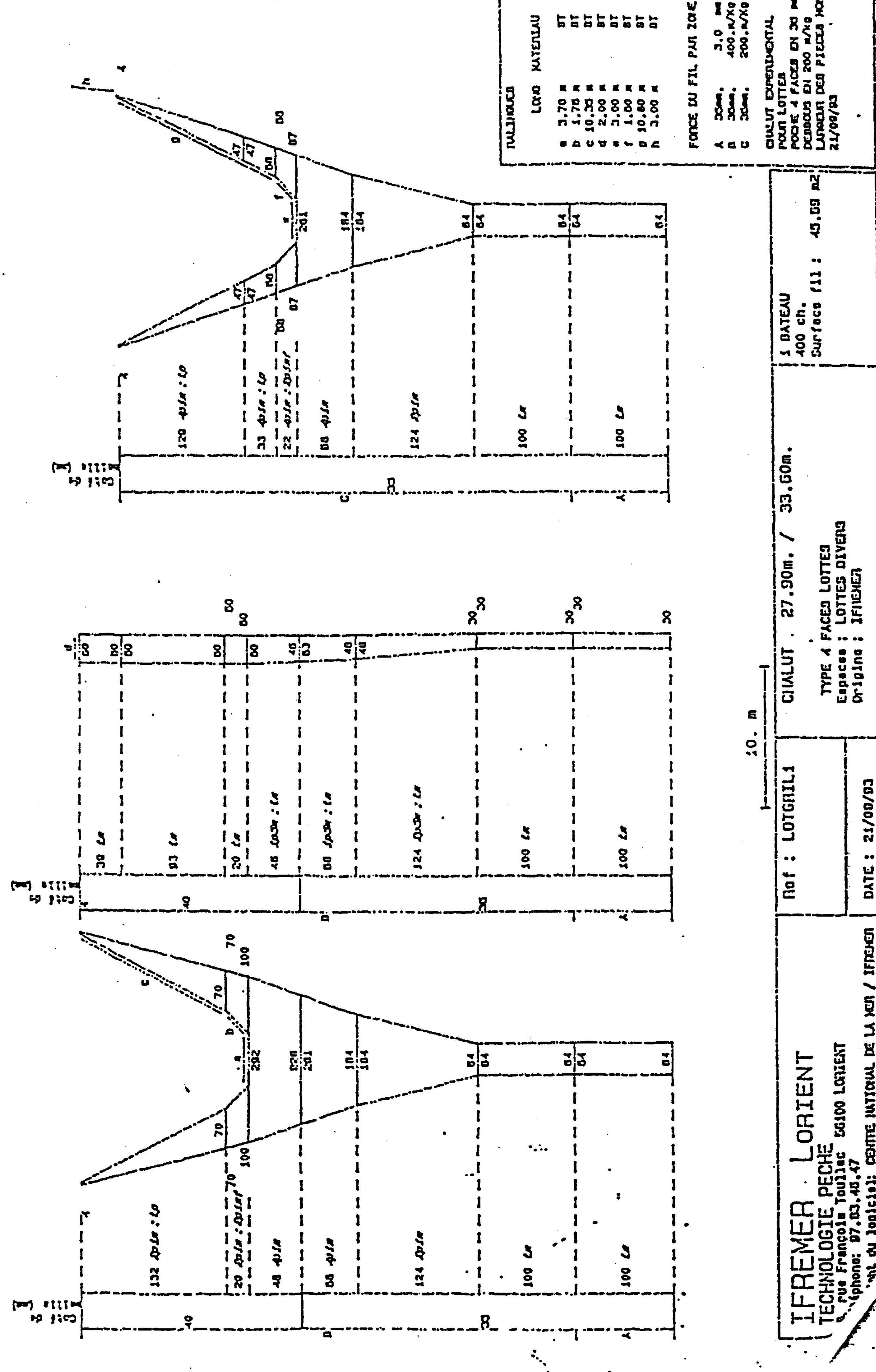


Figure 1: Selective trawl design.

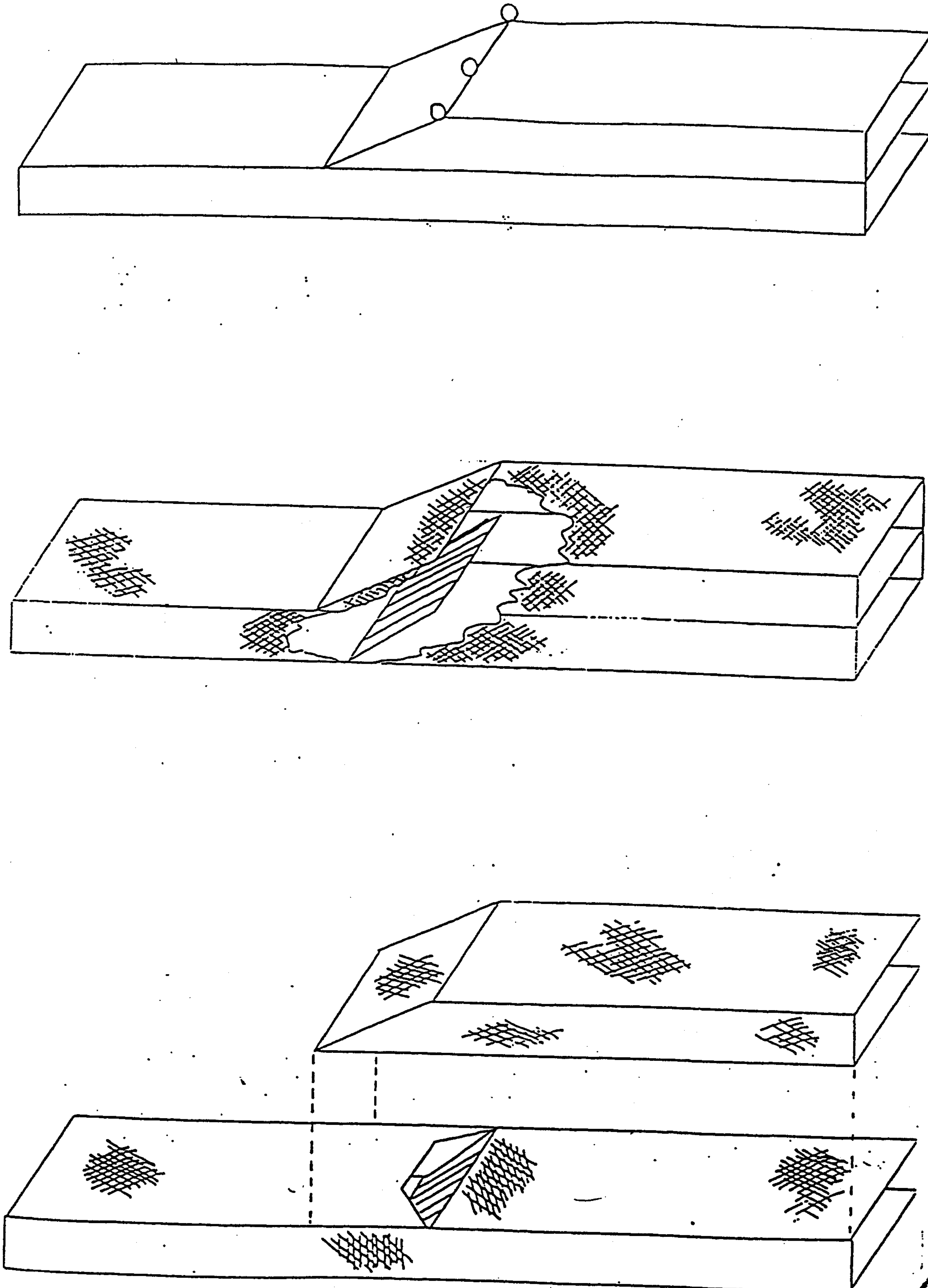


Figure 1- Représentation schématique de l'arrière du chalut montrant l'emplacement de la grille et des deux poches.

Table 1. Size selectivity of various grilles targeting monkfish in France.

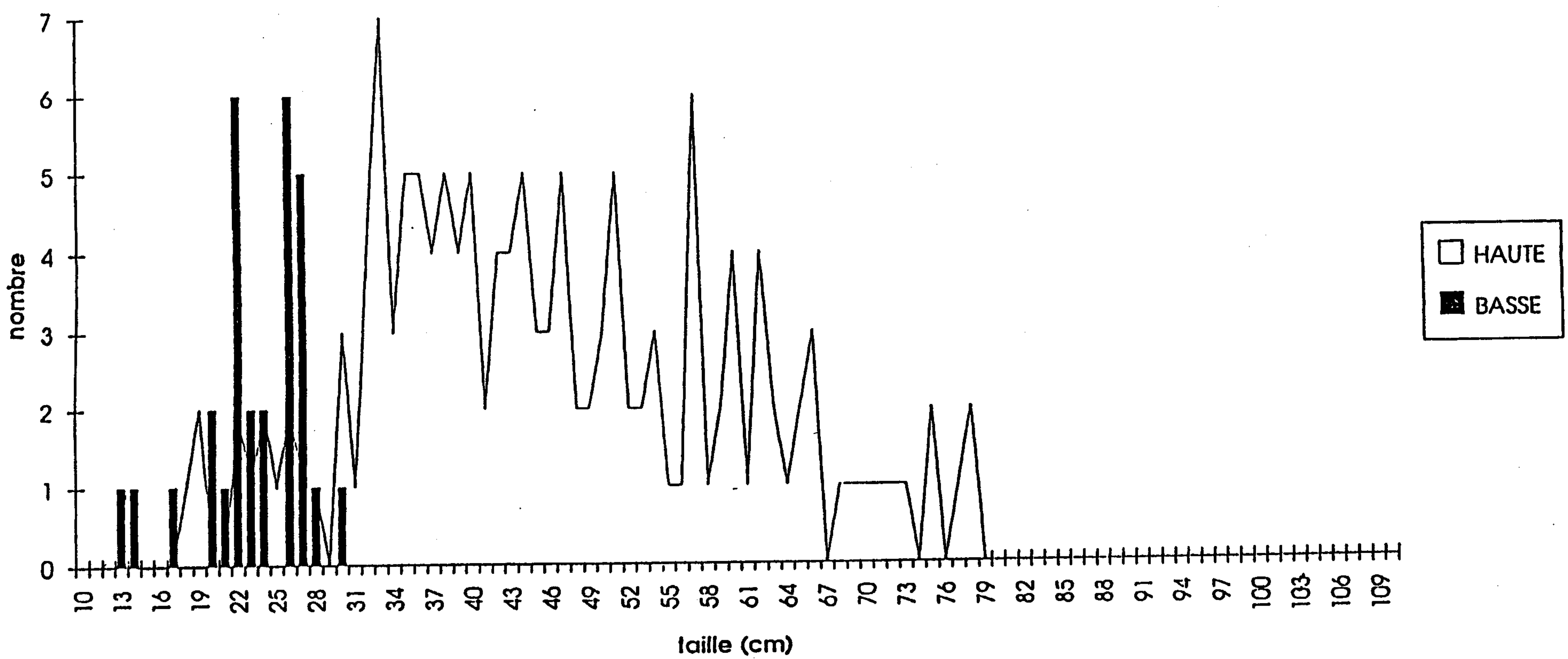
Grille	Disposition	Number of fish		Total weight (kg)	
		Escapees	Retained by grille	Escapees	Retained by grille
110 x 50 mm	Sub-legal	28 (68%)	13 (32%)	5.2 (69%)	2.4 (31%)
	Legal (> 30 cm)	1 (1%)	130 (99%)	.4 (0%)	130 (99%)
110 x 65 mm	Sub-legal	69 (78%)	19 (22%)		
	Legal (> 30 cm)	10 (8%)	110 (92%)	5%	95%
77.5 mm	Sub-legal	12 (75%)	4 (25%)		
	Legal (> 30 cm)	86 (45%)	106 (55%)	26%	74%
55 mm	Sub-legal	40 (63%)	23 (37%)		
	Legal (> 30 cm)	5 (4%)	122 (96%)	6%	94%
40 mm	Sub-legal	48 (70%)	21 (30%)		
	Legal (> 30 cm)	4 (3%)	135 (97%)	4%	96%

Literature:

M. Meillat, H. DuPouy, G. Bavouzet, B. Kergoat, F. Morandeau, O. Gaudou, and J.P. Vacherot. c. 1994. Preliminary results of a trawl fitted with a selective grid for the fishery of benthic species from Celtic Sea and Bay of Biscay. Conseil International pour l'Exploration de la Mer. 18 pp.

M. Meillat, H. DuPouy, J.P. George, J.P. Vacherot, and F. Morandeau. 1995. Compte-rendu de la mission Select 6 sur le chalut selectif a baudroies. l'Ifremer, Direction de l'Ingenierie, de la Technologie et de l'Informatique. 40 pp.

Répartition en taille - BAUDROIE - Grille mixte (110/50) - Select6



APPENDIX IV

DESCRIPTION OF ESSENTIAL FISH HABITAT FOR MONKFISH

Essential Fish Habitat Source Document:

Goosefish (monkfish), *Lophius americanus*, Life History and Habitat Characteristics

F. Steimle, W. Morse, and D. Johnson
National Marine Fisheries Service, Highlands, NJ, 07732

August 1998

INTRODUCTION

The goosefish (*Lophius americanus*), the common name recognized by the American Fisheries Society (Robins *et al.* 1991), is a large, slow-growing, bottom-dwelling anglerfish (Lophiiformes) (Figure 1); "angler" is an older common name for this fish. The goosefish occurs from the southern and eastern parts of the Grand Banks, (Newfoundland) and the northern side of the Gulf of St. Lawrence, to the east coast of Florida (to about 29° N), but is common only north of Cape Hatteras (North Carolina). It was once considered indistinct from the European angler (*L. piscatorius*; e.g. Connolly 1920). Specimens noted in the literature from the Caribbean and Gulf of Mexico (e.g., Bigelow and Schroeder 1953; Jean 1965) were probably misidentified (Caruso 1983). South of Cape Hatteras, it is sympatric with the black-lined goosefish (*L. gastrophysus*) in deep water (Caruso 1983; Armstrong *et al.* 1992). Gabriel (1992) included goosefish in a cold water group composed of American plaice (*Hippoglossoides platessoides*), redfish (*Sebastes* sp.), witch flounder (*Glyptocephalus cynoglossus),* cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), and pollock (*Pollachius virens*), although others suggested affinities with warmer temperate waters (Jean 1965; Scott and Scott 1988; Brown *et al.* 1996).

In U.S. waters, the species is managed under the Northeast Multispecies Fishery Management Plan of the New England Fishery Management Council (New England Fisheries Management Council 1993). The population is currently managed as two stocks (north and south of Georges Bank), although there are few biological differences between them. This Essential Fish Habitat source document provides information on the life history and habitat requirements of goosefish inhabiting U.S. waters.

LIFE HISTORY

The goosefish is a solitary ambush predator of invertebrates and fish. It grows to about 140 cm total length (TL), although few are found greater than 100 cm TL, and can weigh up to about 22 kg (Bigelow and Schroeder 1953). Females attain a larger size than males; males typically live about 9 years and females about 11 years (Armstrong *et al.* 1992; Hartley 1995). The species has several unusual aspects to its life history, including releasing its eggs in long, floating, mucus veils.

Eggs

The eggs are relatively large (1.6-1.8 mm) and are shed within buoyant, ribbon-like, non-adhesive, mucoid veils or rafts, that may be 6-12 m long and 0.15 to 1.5 m wide, and weigh >5 kg (Connolly 1920; Martin and Drewry 1978; Armstrong *et al.* 1992). The method of fertilization has not been observed or reported. The egg veils float freely at the surface and are subject to the actions of wind, currents, and waves. Individual eggs, shed from the mucus veil, are also reported to be buoyant (Connolly 1920). The mucus veil manner of egg production is thought to be unique among fishes. The veils could contain obnoxious or toxic substances to repel potential predators and may offer some protection from predation on individual eggs (Armstrong *et al.* 1992). A veil of eggs from one female is estimated to contain from 1,320,000 to 3,204,400 eggs (Connolly 1920; Berrill 1929). The time to hatching ranges from 6-7 days at 15°C to approximately 100 days at 5°C (Scott and Scott 1988).

Larvae

Newly hatched larvae (2.5-4.5 mm TL) remain protected in the open egg chamber within the egg veil for 2-3 days after hatching (Connolly 1920; Dahlgren 1928) and, upon release, are pelagic and inhabit the water column. When released from their egg chamber, the larvae float with their yolk sac upwards. The yolk is normally absorbed by the time the larvae are 6-8 mm. Connolly (1920), Fahay (1983), and Caruso (in press) describe larval development; the larvae are quite different in appearance from the adult; they are laterally flattened with elongated dorsal and pectoral fin rays.

Goosefish larvae are a common component of the ichthyoplankton community in the Middle Atlantic and Southern New England areas. Larval goosefish in the Middle Atlantic Bight belong to a continental shelf assemblage that includes the larvae of bluefish (*Pomatomus saltatrix*), *Urophycis* hakes, butterfish (*Peprilus triacanthus*), cunner (*Tautogolabrus adspersus*), and several flatfish species (Cowen *et al.* 1993). Sherman *et al.* (1984) listed goosefish as a minor contributor (1.1% of total larvae) in the spring larval fish assemblage in the Middle Atlantic Bight, although it was probably collected in other seasons at lower abundance levels.

An ongoing U.S. Army Corps of Engineers beach replenishment study of the shore zone of north-central New Jersey collected 149 goosefish larvae from summer 1996 ichthyoplankton net tows through the surf zone; 142 of these larvae were collected in June

1996 (D. Clark, US Army Corps of Engineer, CEWES-ER-C, Vicksburg MS, personal communication). It was the third most abundant larva to be collected, composing 8.1% of the total number of fish larvae collected that year, and occurred in 36.4% of the 1996 ichthyoplankton tows. Only one goosefish larva was collected from the surf zone in 1995.

Larval to juvenile transition occurs at 5-10 cm TL when the elongate fins and body gradually assume the adult form (Fahay 1983) and may take several weeks to months (Connolly 1920; Wood 1982). This morphological transformation coincides with the transition from a pelagic to a benthic existence; the areas or habitats in which this transition occurs are poorly known.

Juveniles

Juveniles are dorsally flattened, similar to the adult form, with a large mouth for a life on the seabed. Caruso (in press) reported the collection of juveniles in trawls at sizes as small as 76 mm TL and slightly above 100 mm TL. The size of juvenile goosefish (64-76 mm TL) captured in the fall may represent growth during their first season. Scott and Scott (1988) reported a slightly lower young-of-the-year, pre-winter growth at 59 mm TL in northern waters. They suggested that juveniles 100-114 mm TL collected in late summer could be in their second year. Wood (1982) stated that goosefish grow about 100 mm per year. However, Armstrong *et al.* (1992) reported faster growth rates, i.e., goosefish reached a mean length of 168 mm TL in the first year and a mean of 420 mm TL at age 3. Hartley (1995) gives lengths-at-age at 1 year as 120-139 mm TL for Gulf of Maine fish. Armstrong *et al.* (1992) reported little difference in growth between the sexes until about 4 years of age, after which female growth was greater.

Adults

Adults spend most of their time resting on the bottom, often in a depression or partially covered in sediment. They favor open sandy bottoms upon which they can partially bury to support their ambushing method of predation. Movement is by slow swimming or by using their sturdy pectoral fins to "walk." However, they have been reported at the surface, often after a storm (Connolly 1920), and preying on sea birds (Bigelow and Schroeder 1953). Growth rates reported by Scott and Scott (1988) for the following sizes and otolith bands are 79 cm (9 bands), 94 cm (10 bands), and one fish 102 cm (12 bands; Connolly 1920). After rapid growth (10-11 cm/yr) as juveniles, the annual growth of adults slows to about 7-8 cm/yr (Armstrong *et al.* 1992). They also suggested that growth can be slower in colder waters north of Cape Cod. This was not the case in another study where there was little difference in von Bertalanffy growth parameters between fish from the Gulf of Maine and Georges Bank (Northeast Fisheries Science Center 1992).

Wilk *et al.* (1978) examined 939 goosefish (60-1350 mm TL) collected in the New York Bight in 1974-75 and developed the following length-weight relationships ($\log W = a + b \log L$): $\mathrm{Log}\ W = -4.065 + 2.735 (\log L)$ for males, $\mathrm{Log}\ W = -4.349 + 2.842 (\log L)$ for females, and $\mathrm{Log}\ W = -4.594 + 2.928 (\log L)$ for both sexes, where W = whole weight (g), L = total length (mm), and a and b are fitted constants. Almeida *et al.* (1995) give a length (TL, mm) to total weight (TW, g) relationship for the sexes combined as: $TW = 0.0000410{*}TL^{2.849}$.

Reproduction

Both sexes of goosefish begin to mature at about 30 cm TL. Most males are mature at about 50 cm TL and most females are mature at about 60 cm TL (Almeida *et al.* 1995), which corresponds to about 4 years of age for males and 5 years for females (Wood 1982). Estimates of median length at 50% maturity are 32.0 - 43.3 cm TL for males and 36.1- 48.0 cm TL for females; lengths at maturity are slightly higher in northern waters (Armstrong *et al.* 1992; Almeida *et al.* 1995; Hartley 1995; New England Fishery Management Council 1997). Hartley (1995) reported median lengths at maturity for Gulf of Maine fish as 32 cm TL for males and 36 cm TL for females. However, Caruso (in press) reported that only a few fish were mature at <76 cm TL. Size-at-age data in Armstrong *et al.* (1992) suggest that the age at maturity in recent years has declined to about 3 years for males and 3-4 years for females. Hartley (1995) reviewed length-at-maturity studies and found that from 1975 to 1993 the length at maturity for females decreased from about 45 cm to 36 cm TL, possibly in response to changes in population abundance and exploitation rates.

Spawning occurs from spring through early fall with a peak in May-June (Wood 1982; Armstrong *et al.* 1992). Goosefish spawn in the early spring off the Carolinas, in May-June in the Gulf of Maine, and into September in Canadian waters (Scott and Scott 1988; Hartley 1995). Peak gonadosomatic indices (gonad weight/fish weight, GSI) occurred in March-June for males and in May-June for females (Armstrong *et al.* 1992). Spawning locations are not well known, but are thought to be on inshore shoals or offshore (Connolly 1920; Wood 1982; Scott and Scott 1988).

Armstrong *et al.* (1992) reported that fecundity ranges from 300,000 to 2,400,000 eggs for females between 61 and 105 cm TL. They described the relationship of total length (TL mm) to fecundity by the equation: Fecundity = 4,495.04 (TL) - 2,403,814.8. Connolly (1920) and Berrill (1929) estimated that the number of eggs in a single veil ranged from about 1 to 3 million.

Food Habits

Larvae feed on zooplankton, including copepods, crustacean larvae, and chaetognaths (Bigelow and Schroeder 1953). Small juveniles (5-20 cm TL) start eating fish, such as sand lance *Ammodytes* sp., soon after they settle to the bottom, but invertebrates, especially crustaceans such as red (bristle-beaked) shrimp (*Dichelopandalus leptocerus*) and squid, can make up a large part of their diet. The consumption of invertebrates decreases among larger juveniles (20-40 cm TL) and goosefish >40 cm TL eat few invertebrates (Armstrong *et al.* 1996). In the Northeast Fisheries Science Center food habits database, the diet of goosefish ~30 to 120 cm TL (n = 1,108) was 60-95% fish by volume. Interestingly, the 1973-80 data suggest an increased use of fish with increasing TL, while the 1981-90 data suggest a decreased use of fish with increasing TL; however, the stomach examination methods differed between the two periods. There was little variation in major contributors to the diets over different seasons or areas, although molluscs (mostly squid) were only important south of Georges Bank. Diets can vary regionally and seasonally, depending on what is available as prey (Bigelow and Schroeder 1953).

Goosefish are opportunistic feeders; prey found in their stomachs include a variety of benthic and pelagic species. Goosefish collected during the Northeast Fisheries Science Center bottom trawl survey consumed primarily crustaceans (arthropods), squid (molluscs), and fish (Figure 2). Goosefish eat spiny dogfish (*Squalus acanthias*), skates (*Raja* spp.), eels, sand lance, herring, Atlantic menhaden (*Brevoortia tyrannus*), smelt (Osmeridae), mackerel (*Scomber* sp.), weakfish (*Cynoscion regalis*), cunner, tautog (*Tautoga onitis*), black sea bass (*Centropristis striata*), butterfish, pufferfish, sculpins, sea raven (*Hemitripterus americanus*), sea robins (*Prionotus* spp.), silver hake (*Merluccius bilinearis*), tomcod (*Microgadus tomcod*), cod, haddock, hake (*Urophycis* spp.), witch and other flounders, squid, large crustaceans, and other benthic invertebrates (Field 1906; Bigelow and Schroeder 1953; Wood 1982; Sedberry 1983; Vinogradov 1984; Armstrong *et al.* 1996). The goosefish can also eat sea birds and diving ducks (Bigelow and Schroeder 1953) and will attack non-living objects, such as lobster trap floats (Connolly 1920). Cannibalism (non-kin, inter-cohort) is important and perhaps explains the apparent high mortality of smaller males (Armstrong *et al.* 1992; 1996). Larger goosefish eat larger prey (Sedberry 1983) and often have empty stomachs (Armstrong *et al.* 1996). In the Northeast Fisheries Science Center diet database for 1973-1990, 50-70% of the stomachs of fish 20-110 cm TL were empty and 1-20% of the stomachs of fish ~120 cm TL were empty.

Goosefish catch their prey by ambush or in a sudden rush. The rapid opening of the large mouth creates a vacuum and the prey are caught in needle-like, backward-curving teeth (Armstrong *et al.* 1996; Gosline 1996). Like most anglerfish, a small, dangling, lure-like appendage above the mouth is used to attract small fish. This lure can be only effective in shallow, adequately lighted waters (Gosline 1996). Bigelow and Schroeder (1953) reported that a goosefish meal could equal half their body weight.

Predation

Adult goosefish have few enemies (Wood 1982). However, smaller fish are cannibalized and swordfish (*Xiphias gladius*) have been reported to eat goosefish (Scott and Scott 1988). In the Northeast Fisheries Science Center food habits database, goosefish were eaten by (number of goosefish consumed in parentheses): spiny dogfish (12), thorny skate (*Raja radiata*, 2), goosefish (2), smooth dogfish (*Mustelus canis*, 2), cod (2), sandbar (*Carcharhinus plumbeus*, 1), and dusky shark (*C. obscurus*, 1). The frequency of occurrence of goosefish in predator stomachs was <2% for these species and <1% for most predator species. Stillwell and Kohler (1993), however, reported that goosefish made up 16.1% of the total volume of food in 20 sandbar sharks stomachs examined from the Middle Atlantic Bight.

Migration

Goosefish make seasonal inshore-offshore migrations that appear to be thermally induced in Canadian waters (Jean 1965) and off Nantucket Shoals (Almeida *et al.* 1995), although in opposite directions. In the Gulf of Maine, large, sexually mature goosefish inhabit deeper, cooler, more saline waters in the spring, and shallower, warmer, less saline areas in summer and fall (Hartley 1995). Goosefish were more common in shallower waters (25-92 m) during the summer, and in deeper waters (180-225 m) during the winter (Jean 1965; Scott and Scott 1988; Hartley 1995). A nearly opposite distributional trend occurred for goosefish <20 cm, which were most abundant offshore in the summer and fall, and inshore in the spring (Hartley 1995). South of Cape Cod, goosefish occur across most of the continental shelf in the spring. They are more concentrated inshore west and south of Nantucket Shoals, possibly in response to a summer cold water pool that frequently occurs mid-shelf in the Middle Atlantic Bight (Edwards *et al.* 1962; Wood 1982). South of Nantucket Shoals, the goosefish distribution shifts onshore in winter and offshore in summer, thus avoiding warm inshore waters in summer (Almeida *et al.* 1995).

Stock Structure

North American and European *Lophius* were once considered to be a single species. However, *Lophius americanus* and *L. piscatorius* are now considered separate, although closely related species (Berrill 1929; Grant and Leslie 1993; Caruso, in press). There is no evidence of distinct North American stocks of *L. americanus*. For management purposes, it is separated into a northern component from the Gulf of Maine to northern Georges Bank and a southern component from southern Georges Bank into the Middle Atlantic Bight (Almeida *et al.* 1995).

HABITAT CHARACTERISTICS

Goosefish live in the water column during the egg and larval stages and shift to a benthic existence during their juvenile and adult stages. Goosefish larvae are a common component of the ichthyoplankton community while juveniles and adults spend most of their time resting on the bottom. The characteristics of the habitats where goosefish are commonly collected is summarized in this section and in Table 1.

Eggs

For most or all of this life stage, the eggs occur within a mucus veil in the upper part of the water column. Severe weather can damage the veil and release isolated eggs. Eggs were collected near Cape Lookout (North Carolina) in March and April (Bigelow and Schroeder 1953), in May off Cape Hatteras, and off Southern New England, but not after September. Incubation proceeds at temperatures as low as about 4°C to about 18°C or higher (Caruso, in press). Hatching is estimated to take 100 days at 5°C and 6-7 days at 15°C (Scott and Scott 1988); the upper temperature limit for normal development is 17-18°C.

Larvae

In the National Marine Fisheries Service MARMAP ichthyoplankton survey, larvae were first collected over deeper (>300 m), offshore waters in the Middle Atlantic Bight during March-April; later, larvae were most abundant across the continental shelf at depths between 30 to 90 m (Figure 3). Larvae were most abundant at integrated water column temperatures between 10-16°C, although there was one collection at 4°C in January. Peak catches generally occurred at 11-15°C regardless of the month or area.

Juveniles

In the Northeast Fisheries Science Center bottom trawl survey, juvenile goosefish were collected at bottom water temperatures between 3-13°C in spring and autumn; abundance peaked at ~5-6°C in spring and ~8-12°C in fall (Figure 4). Juvenile goosefish were not collected at temperatures >13°C and at depths <20 m, such as inshore along the Middle Atlantic Bight and on the center of Georges Bank. In the Gulf of Maine (northern stock), Hartley (1995) reported that juveniles were collected from 2.3°C (<20 cm TL fish in winter) to 7.6°C (<34 cm TL fish in fall). Peak catches in the Massachusetts survey occurred at 5-7°C in spring and 8-12°C in autumn (Figure 5). The bimodal temperature distribution is evident in Figure 5, particularly in autumn. This is the result of cooler temperatures north of Cape Cod and warmer temperatures south of the Cape. This can also be seen in the Northeast Fisheries Science Center bottom trawl survey data, but only for spring (Figure 4). The few juvenile goosefish that were collected in Narragansett Bay during the Rhode Island trawl survey (1990-96) were caught at temperatures ranging from 3° to 19°C (Figure 6). Few goosefish were collected in Long Island Sound during the Connecticut trawl survey; most of these appeared to be juveniles that were collected only in the spring at 8-18°C, from 10-40 m in depth, and at salinities between 26-29 ppt (Figure 7).

In the Northeast Fisheries Science Center bottom trawl survey, about 50% of all juvenile goosefish were caught between 25 and 99 m in spring and autumn with peak abundance at about 50-75 m (Figure 4). In the Massachusetts bottom trawl survey, juvenile goosefish occurred in shallower water in the spring (to 5 m) and deeper (>20 m) in the fall (Figure 5). In the Gulf of Maine, juveniles <20 cm TL and juveniles 20-34 cm TL had slightly different mean seasonal depth preferences (Hartley 1995). In the winter-spring, the smallest juveniles were commonly collected in mean depths of 91-177 m, while larger juveniles were collected in mean depths of 113-182 m. During summer-fall, the smallest fish were commonly collected at deeper mean depths, 167-182 m compared to 120-150 m for larger juveniles. In Narragansett Bay, juveniles were usually collected only in >30 m during all seasons (Figure 6).

Hartley (1995) found all stages of goosefish were mostly collected at mean salinities of between 32.6 and 33.9 ppt in the Gulf of Maine.

Scott and Scott (1988), referencing Connolly (1920), state that newly settled juveniles seek protection among algae covered rocks. Richards (1963a) collected one 19.5 cm goosefish in January in Long Island Sound on a 9 m deep, sand-shell bottom. The distribution of goosefish in Long Island Sound (Figure 7) suggests that juveniles occurred most frequently in the deeper, silty basins (Reid *et al.* 1979).

Adults

In the Northeast Fisheries Science Center bottom trawl survey, adult goosefish were collected at bottom water temperatures between 0-24°C and were most abundant between 4-14°C (Figure 4). Adults were commonly collected at spring temperatures of 6-8°C and 11-12°C and at autumn temperatures of 9-11°C. Hartley (1995) found adult abundance peaked at mean bottom temperatures of 5-8°C. Peak catches in the Massachusetts survey had a bimodal temperature distribution, which was the result of cooler temperatures north of Cape Cod and warmer temperatures south of the Cape (Figure 5). In Narragansett Bay, adult goosefish were only collected in the spring and summer at temperatures between 7-14°C (Figure 6). Excessively cold water or a rapid drop in coastal temperatures might be fatal; Sherwood *et al.* (1901) reported fall mortalities of adults near Woods Hole, Massachusetts. Hartley (1995) speculated that these "kills" could also be explained as a result of post-spawning stress.

In the Northeast Fisheries Science Center bottom trawl survey, adults were more abundant in deeper waters (to 500 m) in the spring (Figure 4). Adults were most abundant between 50-99 m and rarely occurred below 200 m in the autumn. In the Gulf of Maine, adults >34 cm TL fish occurred at mean depths of 130-140 m from summer through winter and at 206 m in the spring (Hartley 1995). In the Massachusetts bottom trawl survey, adults were common in <35 m of water in the spring and at 20-60 m in the fall (Figure 5). In Narragansett Bay, adult goosefish were only collected at 32 m where the bay meets Rhode Island Sound (Figure 6). No adults were collected in the Connecticut trawl survey in Long Island Sound.

Salinity preferences vary seasonally, but adults occur between about 30-36 ppt with the mean at about 33.5 ppt (Hartley 1995).

Adults were found on hard sand, pebbly-gravel bottoms, mixed sand and shell, and mud in the Gulf of Maine (MacDonald *et al.* 1984; Caruso, in press) and they preferred clay and mud over sand and gravel on the Scotian Shelf (Scott 1982).

GEOGRAPHICAL DISTRIBUTION

The goosefish occurs from the southern and eastern parts of the Grand Banks, (Newfoundland) and the northern side of the Gulf of St. Lawrence, to the east coast of Florida (to about 29° N), but is common only north of Cape Hatteras, NC (Figure 8). This section is a summary of several surveys of the distribution and relative abundance of goosefish life history stages (methods are summarized by Reid 1998).

Eggs

Spawning has been reported in Canadian waters (Connolly 1920), the Gulf of Maine (Hartley 1995), and south of Cape Cod (Armstrong *et al.* 1992). However, the eggs were only occasionally caught in the National Marine Fisheries Service MARMAP ichthyoplankton survey from the Gulf of Maine to North Carolina. Eggs were not collected in Sandy Hook Bay (Croker 1965) and only rarely in Long Island Sound (Merriman and Sclar 1952; Wheatland 1956), but they have been reported in open coastal bays and sounds in low numbers (Smith 1898; Herman 1963; Caruso, in press).

Larvae

The National Marine Fisheries Service MARMAP ichthyoplankton survey (1977-87) captured goosefish larvae throughout much of the survey area (Figure 9).

Most larvae were collected south of Cape Cod, Massachusetts to Cape Hatteras, North Carolina. The ICNAF data for Canadian waters do not alter this conclusion (Hartley 1995). Significant numbers of larvae were captured from April to September and peak abundance occurred in June and July. Larvae occurred off North Carolina and near the 200 m isobath in April. By May, the larvae were widespread on the shelf from North Carolina to southern New Jersey, and by June, they were found off Southern New England. In July, the larvae were concentrated off New Jersey to just south of Cape Cod; a few were collected on Georges Bank. The numbers of larvae declined during August and September and were scattered from New Jersey to Georges Bank and into the Gulf of Maine.

Although larvae were widely collected in the Middle Atlantic Bight, they are not common and are seldom found inshore. Kendall and Naplin (1981) collected 63 larvae ($0.6/m^3$) in the New York Bight in July 1974. Hildebrand and Schroeder (1928) and Pearson (1941) collected larvae near the mouth of Chesapeake Bay in May-June. Five larvae/post-larvae were collected during May (1979-80) in estuaries near Parramore and Cedar Islands, Virginia (Cowan and Birdsong 1985); 5-8 mm larvae were collected in May 1960 at the mouth of Chesapeake Bay (VIMS 1961). Larvae were not reported in ichthyoplankton surveys of Delaware Bay (Wang and Kernehan 1979), Delaware coastal bays (Scotton 1970), the Gulf of Maine, Cape Cod, or on Georges Bank (Fish 1925; Colton and Byron 1977). They are reported to occur in Long Island Sound and the Hudson-Raritan estuary by Wheatland (1956) and Dovel (1981), but not in Sandy Hook Bay (Croker 1965), Block Island Sound, or Narragansett Bay (Merriman and Sclar 1952; Herman 1963). A relatively large number of goosefish larvae (149) were collected during the summer (mostly in July) 1996 in a study of the surf zone along the New Jersey coast (D. Clark, US Army Corps of Engineers, CEWES-ER-C, Vicksburg MS, personal communication).

Juveniles

Bean (1888) collected young goosefish mid-shelf off Long Island, New York and Smith (1898) collected 10+ cm TL individuals in traps near Vineyard Sound. In the Northeast Fisheries Science Center bottom trawl survey, juvenile goosefish (<43 cm TL) were concentrated offshore (>60 m) from Maryland to Georges Bank and nearshore off Southern New England in winter (Figure 10); they were not collected at the shallowest depths (<20 m) or the coldest temperatures (<3°C). In spring, juvenile goosefish were widespread on the shelf with concentrations off Southern New England and offshore in the Middle Atlantic Bight. Few fish occurred on the shallows of Georges Bank, Nantucket Shoals, or inshore in the Middle Atlantic. Again, goosefish avoided the coldest water and shallowest depths. By summer, juvenile goosefish were most abundant along the western half of the Gulf of Maine and off Southern New England. Their autumn distribution was similar to that in spring. Hartley (1995) reported that immature goosefish were ubiquitous in the Gulf of Maine in spring and autumn 1992-93. Juveniles were approximately four times more abundant than adults in the Massachusetts bottom trawl survey and occurred almost exclusively north of Cape Cod in the cooler waters (Figure 11).

Juveniles are rarely reported in most estuarine surveys from North Carolina to Maine (Derickson and Price 1973; Epperly 1984; Cowan and Birdsong 1985; Jurt *et al.* 1994). Only three juveniles (23-35 cm TL) were collected in the Hudson-Raritan estuary trawl survey (1990-96) and then only in the winter (S. Wilk, NMFS, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ, personal communication). In Narragansett Bay, juveniles (<43 cm TL) were collected in low numbers in all seasons (Figure 12). In the Connecticut trawl survey of Long Island Sound, juveniles were rarely collected in the central Sound (Figure 7).

Adults

Adult goosefish are most common in continental shelf waters less than 668 m; they occur south of New England in waters as deep as 800 m (Schroeder 1955; Schaefer 1967; Markle and Musick 1974; Armstrong *et al.* 1992). In the early 1950s, Schroeder (1955) reported that goosefish was common between 50-450 fathoms throughout its range during summer. A few years later, Fritz (1965) found that autumn catches from New Jersey to Nova Scotia were low and averaged 4 goosefish per 5.5 hr trawl tow. He found them mostly on the periphery of Georges Bank and southeast of Nova Scotia.

In the Northeast Fisheries Science Center bottom trawl survey, adult goosefish occurred offshore in the winter (Figure 10). In the spring they were found in deeper waters off Virginia, inshore along the New York Bight, and offshore off southern New England, Georges Bank, and Gulf of Maine. Adult goosefish were most abundant in the Gulf of Maine during the summer and off southern New England and northwest Georges Bank in the fall. Few large fish are reported below 400 m (possibly a Northeast Fisheries Science Center survey depth limit factor) and they are absent from shallow areas on Georges Bank. Adults also occur in inshore Gulf of Maine in the summer, fall, and winter, and are widely distributed in deeper water in the spring (Almeida *et al.* 1995; Hartley 1995).

Colvocoresses and Musick (1984) considered goosefish to be ubiquitous across the shelf in the Middle Atlantic Bight and associated with silver hake (*Merluccius bilinearis*), fourspot flounder (*Paralichthys oblongus*), spiny dogfish, and red hake (*Urophycis chuss*). De Sylva *et al.* (1962) reported that goosefish was commonly taken by trawlers well up in Delaware Bay in the winter, although it was sometimes found there in moribund condition. Breder (1922) reported a few were collected in the fall in the Hudson-Raritan estuary. Richards (1963b) collected two 61 cm TL goosefish in central Long Island Sound during September and January. Caruso (in press) reported that goosefish congregate beneath shoals of herring and Wood (1982) suggested that food availability could affect seasonal distributions, at least in the Middle Atlantic Bight.

In the Massachusetts bottom trawl survey in the spring, adult goosefish occurred throughout the survey area except in Buzzards Bay and Nantucket Sound (Figure 11). Adults, like juveniles, were not abundant anywhere in the survey area (maximum catch was 6 fish). Autumn catches of adults were mainly north and east of Cape Cod. The seasonal change in distribution in the Gulf of Maine (inshore in summer and offshore in winter) is evident in the Massachusetts data. Adults were widely distributed in spring, north and south of Cape Cod and had no temperature preference. In autumn, adults were distributed north of the Cape and thus occur in cooler waters. In spring, adults were found at all depths but were most abundant between 30 and 60 m. In autumn, adults were found at all depths with a peak at 30 m. Adults were collected at the mouth of Narragansett Bay in low abundance in the spring and summer during the Rhode Island bottom trawl survey (Figure 12).

STATUS OF THE STOCKS

Goosefish were once considered bycatch and "trash fish" in trawls, scallop dredges, and on hook and line. Until the early 1970s, those that were landed were mostly processed for fishmeal, although they were long considered a delicacy in Europe. Since the 1970s, goosefish tails began appearing more frequently in markets and restaurants. Landings increased significantly after 1972, almost doubling for a few years (Wood 1982), and reached 19,000 MT in the 1990s (National Marine Fisheries Service 1995). Recently, an oriental export market has developed for goosefish livers (Almeida *et al.* 1995).

The stocks of this species and average size caught have declined dramatically as the harvests have increased (National Marine Fisheries Service 1995; Figure 13). The Northeast Fisheries Science Center autumn trawl index for goosefish declined sharply over the past 15 years for the northern and southern stocks (National Marine Fisheries Service 1995; Northeast Fisheries Science Center 1997; New England Fishery Management Council 1997). The peak in survey catches occurred during 1977-81 and record low catches have occurred since 1992.

Comparisons were made between the distribution of juvenile and adult goosefish between a period of high population abundance (1977-81) and a period of low abundance (1992-96). The two areas of high juvenile abundance in 1977-81 (southern New England and the Middle Atlantic) showed a dramatic decline in abundance by 1992-96 (Figure 14). Catches of juveniles increased on Georges Bank and in the Gulf of Maine between these periods. In recent years, adults are nearly absent in the spring survey from areas of traditional high abundance south of Cape Cod. The highest catches are now in the Gulf of Maine. The stocks of this species are currently considered overfished, which for goosefish is defined as NEFSC survey catches less than 33% of the mean abundance index for the period 1963-94 (National Marine Fisheries Service 1997).

RESEARCH NEEDS

- The scarcity of eggs and larvae in the Gulf of Maine, and eggs (veiled or unveiled) in ichthyoplankton studies, in general, needs attention (Caruso, in press).
- Better estimates of abundance and distribution are needed beyond the continental shelf break. i.e., deeper than 350 m (Northeast Fisheries Science Center 1992).
- Better age and growth data, especially for the Middle Atlantic Bight, are needed for both sexes (Northeast Fisheries Science Center 1992).
- The possibility of critical spawning areas should be investigated.
- Better information is needed on the egg

incubation period and early larval development.

- The duration of the pelagic larval phase needs better estimation; larval prey need to be determined.
- More information is needed about the habitat and survival requirements of recently settled juveniles.
- The role of the mucus veil in egg incubation and protection is poorly known.
- Are the occasional adult mortalities found on beaches in the fall mostly post-spawned females?
- How important is the surf zone in the Middle Atlantic Bight for goosefish larvae?

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Table 1. Summary of life history and habitat parameters for goosefish, *Lophius americanus*. (MAB = Middle Atlantic Bight; SNE = southern New England; GB = Georges Bank; GOM = Gulf of Maine)

Life Stage	Time of Year	Size and Growth	Geographic Location	Habitat	Substrate
Eggs	March - September, south to north, peak in June.	1.6-1.8 mm diameter; hatch in 7-100 days	Rarely collected, inner to mid continental shelf, SNE, and MAB; not in estuaries.	Upper water column, see notes	(pelagic)
Larvae	March - September, south to north, peak in June-July.	2.5-4.5 mm at hatching; transition to juvenile at 5-10 cm	Mainly mid-shelf in SNE and MAB; few on GB, in GOM or inshore (but see note).	Upper to lower water column, at depths of 15 to >1000 m; mostly 30-90 m.	(pelagic)
Juveniles	All months	6.4 to ~ 43 cm TL; can grow ~10-15 cm TL/yr.	GOM: offshore in summer/fall, inshore in winter/spring; Southern GB, SNE: mostly mid to outer shelf; MAB: mostly outer shelf	Seabed, > 20 m, peak abundance at 40-75 m.	Mud to gravelly sand, algae, and rocks.
Adults	All months	43 to ~120-140 cm; grow ~7-8 cm/yr.; females grow faster than males. No difference in growth between GOM and MAB.	GOM: offshore in spring, inshore in summer fall; SNE/MAB: inshore in winter, offshore in summer fall	Seabed, 1 - 800 m, most 50 - 99 m, sometimes at surface. GOM: 130 - 206 m.	Mud to gravelly sand, algae and rocks.
Spawning Adults	February - August, south to north; peak in May.	Maturity at ~32 cm (males), 36 cm females.	Mid-continental shelf off SNE and MAB, some in GOM.	Same as adults.	Same as adults (?).

Table 1. cont'd.

Life Stage	Temperature	Salinity	Prey	Predators	Notes
Eggs	4-18°C or higher				Contained in long mucus veils that float near or at surface.
Larvae	6-20°C, most in 11-15°C		Probably zooplankton.		A recent study collected 149 larvae in the surf along central NJ in summer 1996.
Juveniles	2-24°C, most 3-13°C; cooler in GOM.	GOM: 30-36 ppt; mean 33.5 ppt	Small fish, shrimp, and squid; the proportion of fish increases with fish size.	Various sharks, skates, cod, and monkfish.	
Adults	Seasonally variable, 0 - 24°C; mostly 4 - 14°C.	GOM: 30-36 ppt; mean 33.5 ppt	Mostly fish, some crustaceans, molluscs, and occasionally seabirds; varies with availability.	Some of those listed for juveniles.	Cold water or post-spawning mortalities reported in fall.
Spawning Adults	Same as adults (?).	Same as adults (?)	Same as adults (?)	Same as adults (?)	In GOM, size-at-maturity decreased from 45 cm to 36 cm since 1975.

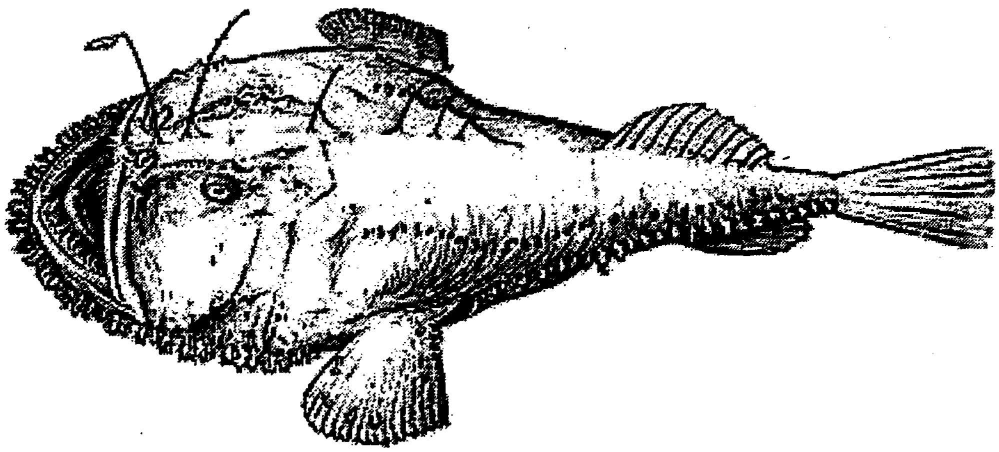
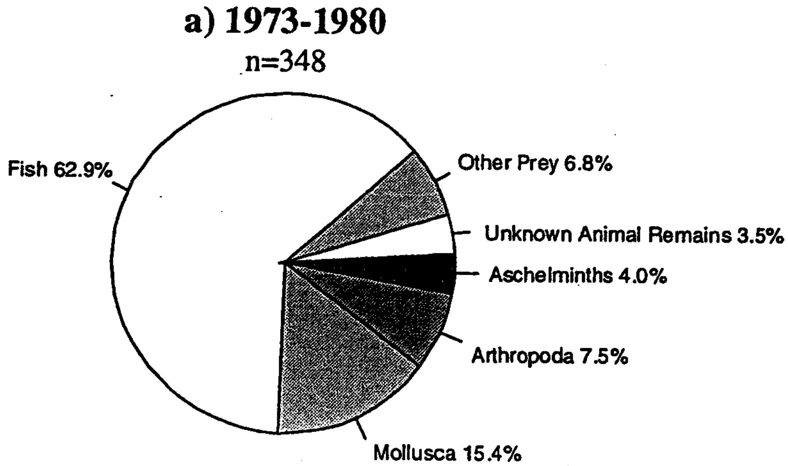


Figure 1. The adult goosefish (or monkfish), *Lophius americanus*.



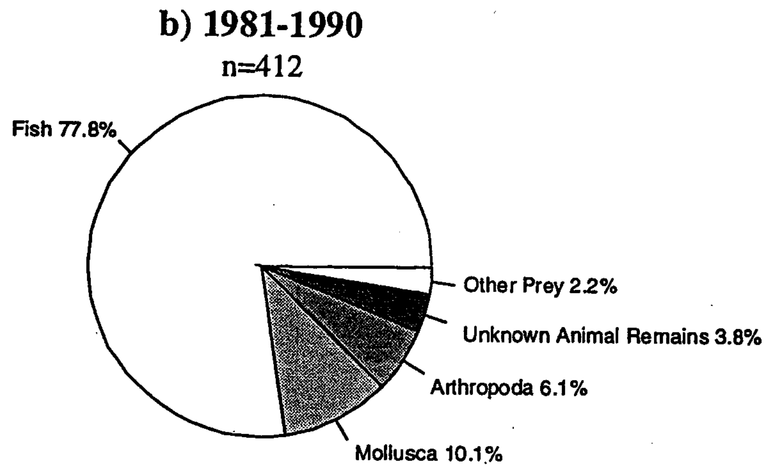


Figure 2. Abundance of the major prey items in the diet of goosefish from NEFSC bottom trawl survey data on food habits for 1973-1980 and 1981-1990 (see Reid 1998).

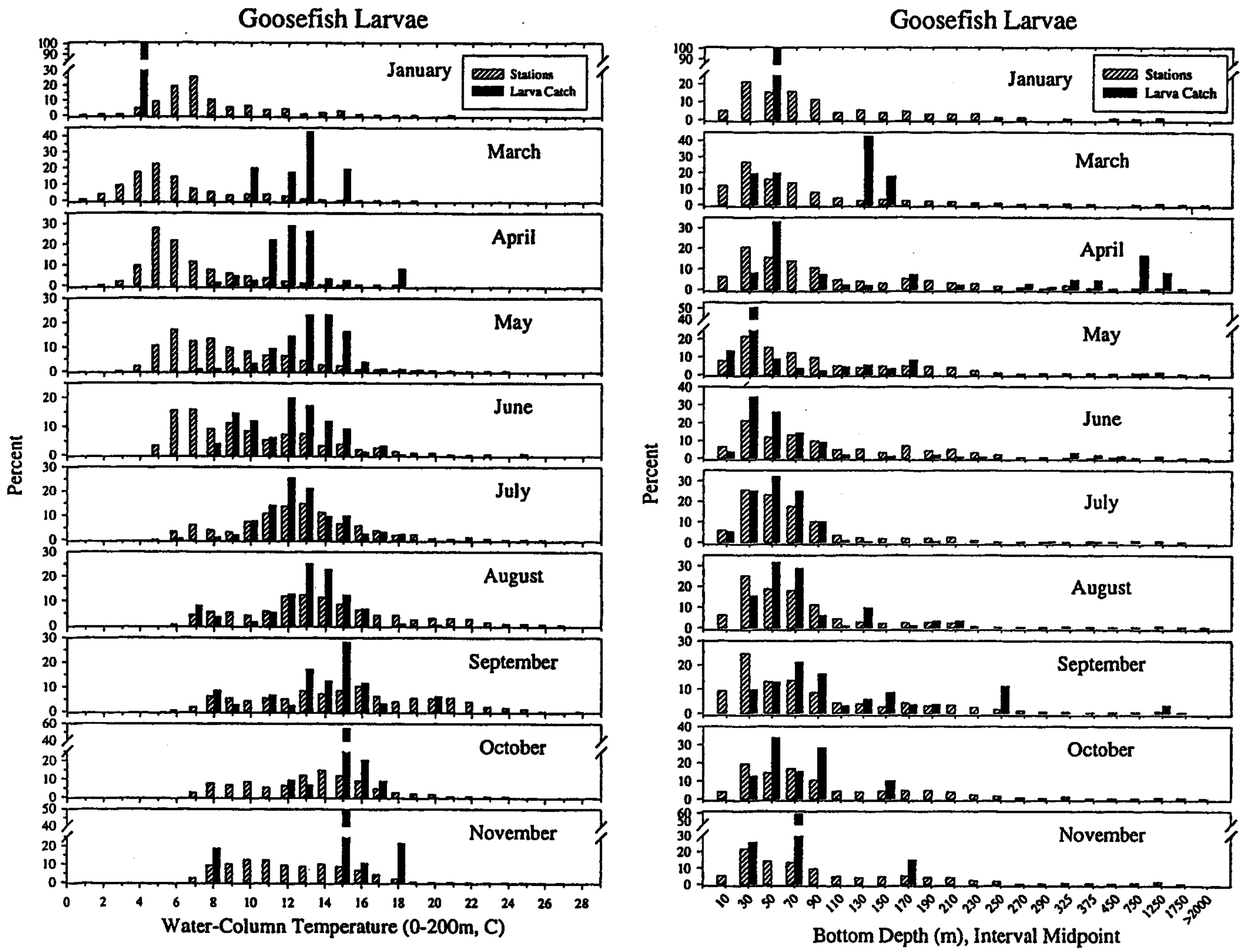


Figure 3. Association of goosefish larvae with integrated water column temperature and bottom depth from the NEFSC MARMAP ichthyoplankton survey, 1977-1987.

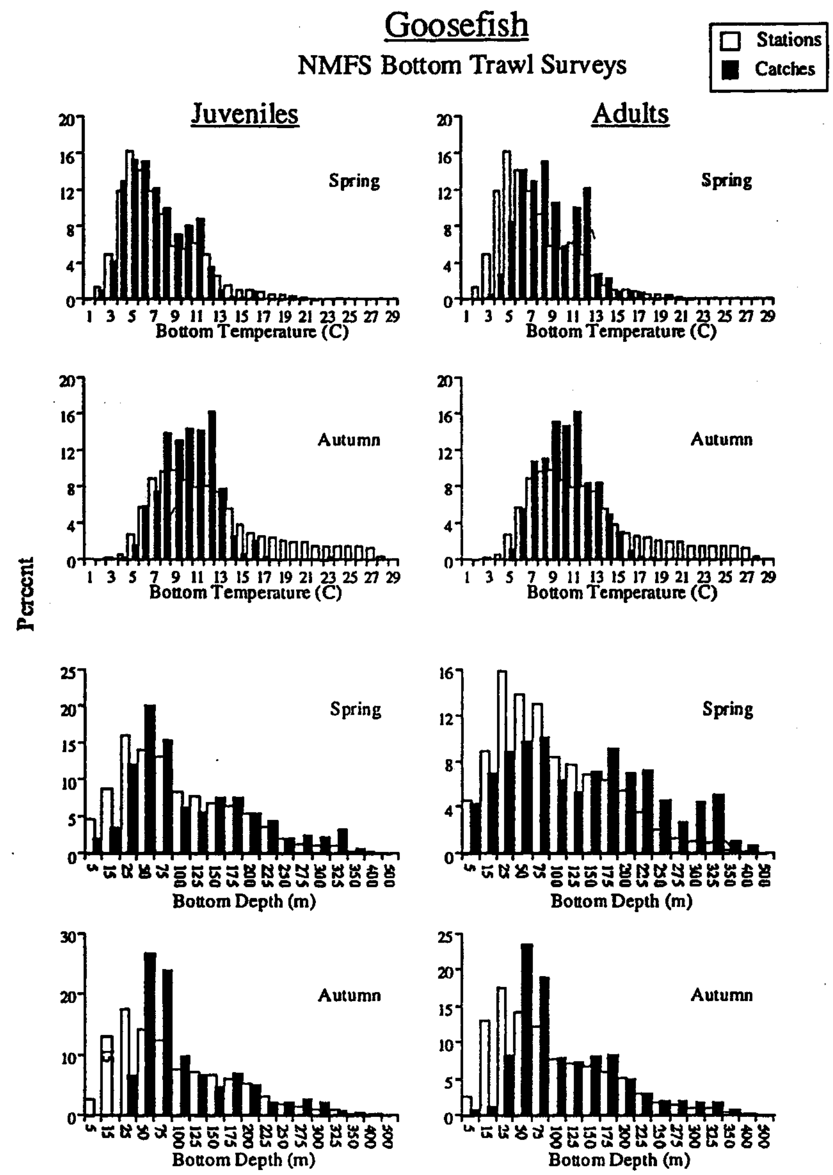


Figure 4. Association of juvenile and adult goosefish with bottom temperature and depth from the NEFSC bottom trawl survey, 1963-1997.

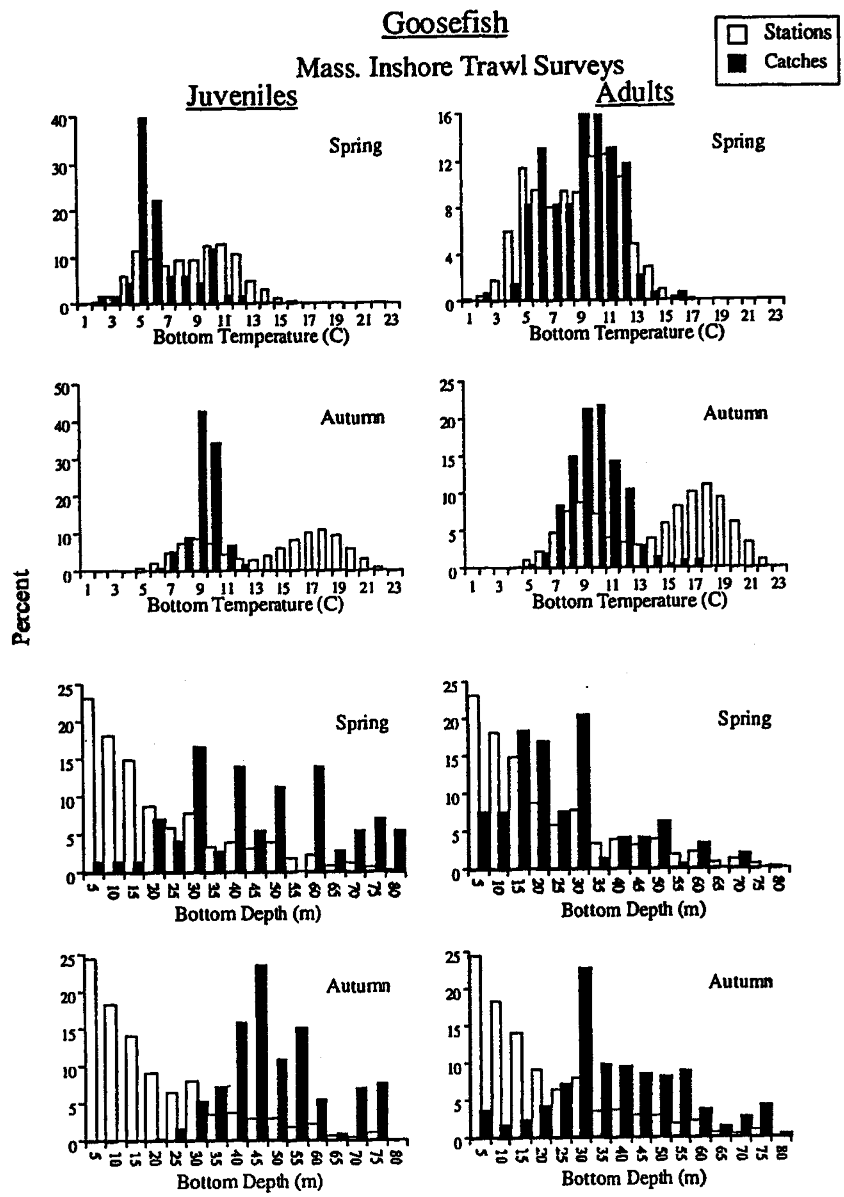


Figure 5. Association of juvenile and adult goosefish with bottom temperature and depth from the Massachusetts bottom trawl survey, 1978-1996.

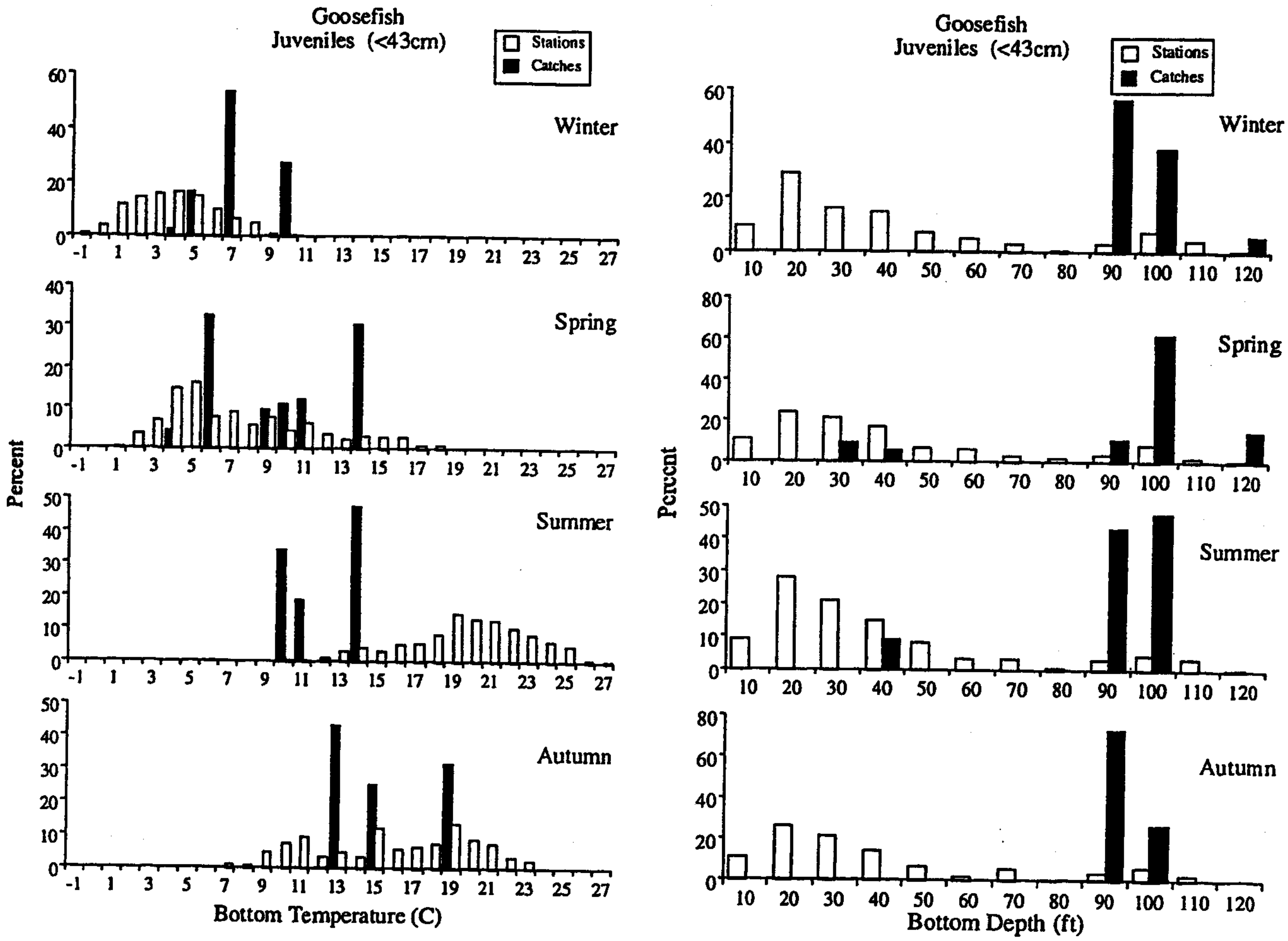
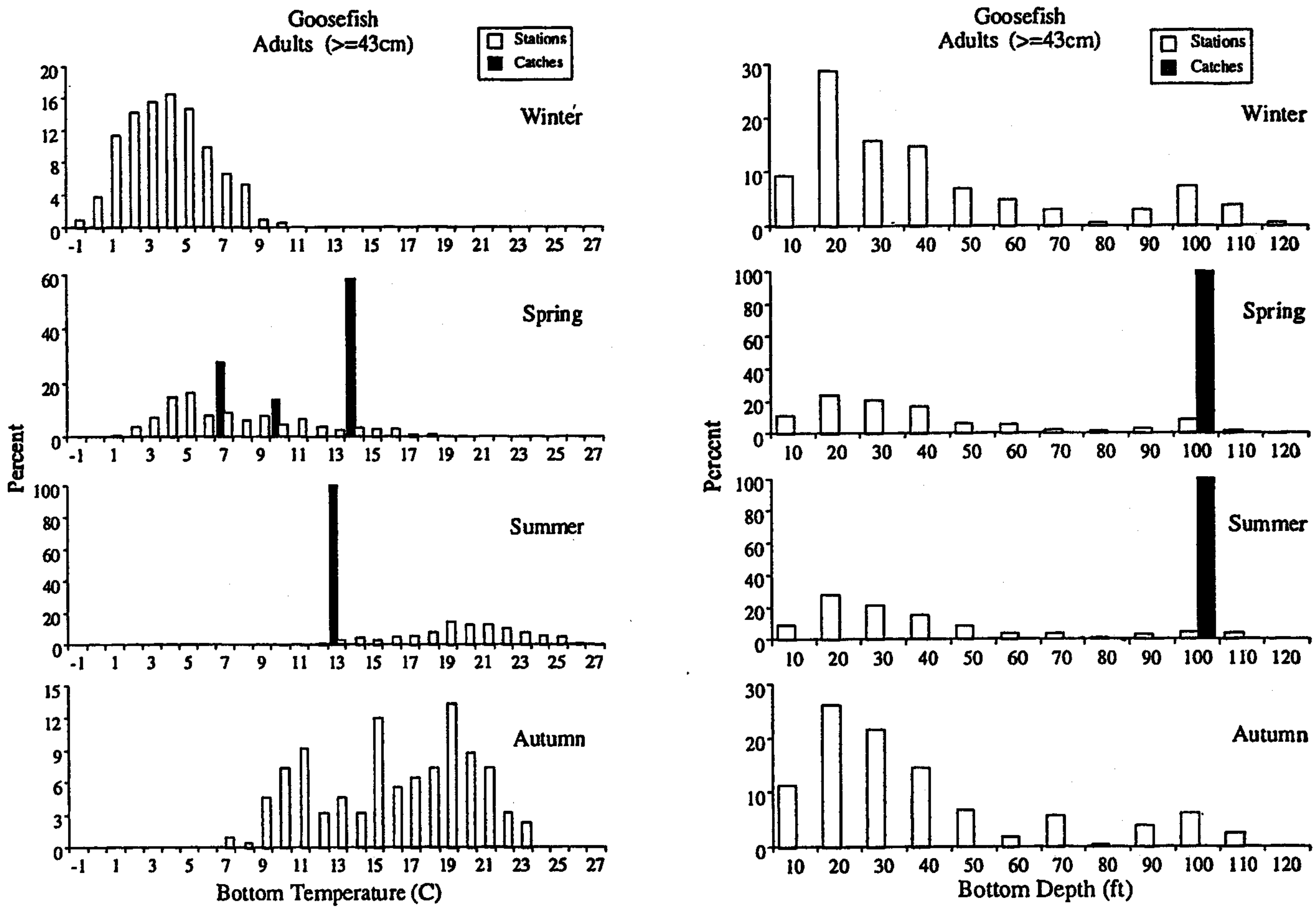


Figure 6. Association of juvenile and adult goosefish with bottom temperature and depth from the Rhode Island bottom trawl survey in Narragansett Bay, 1990-1996.



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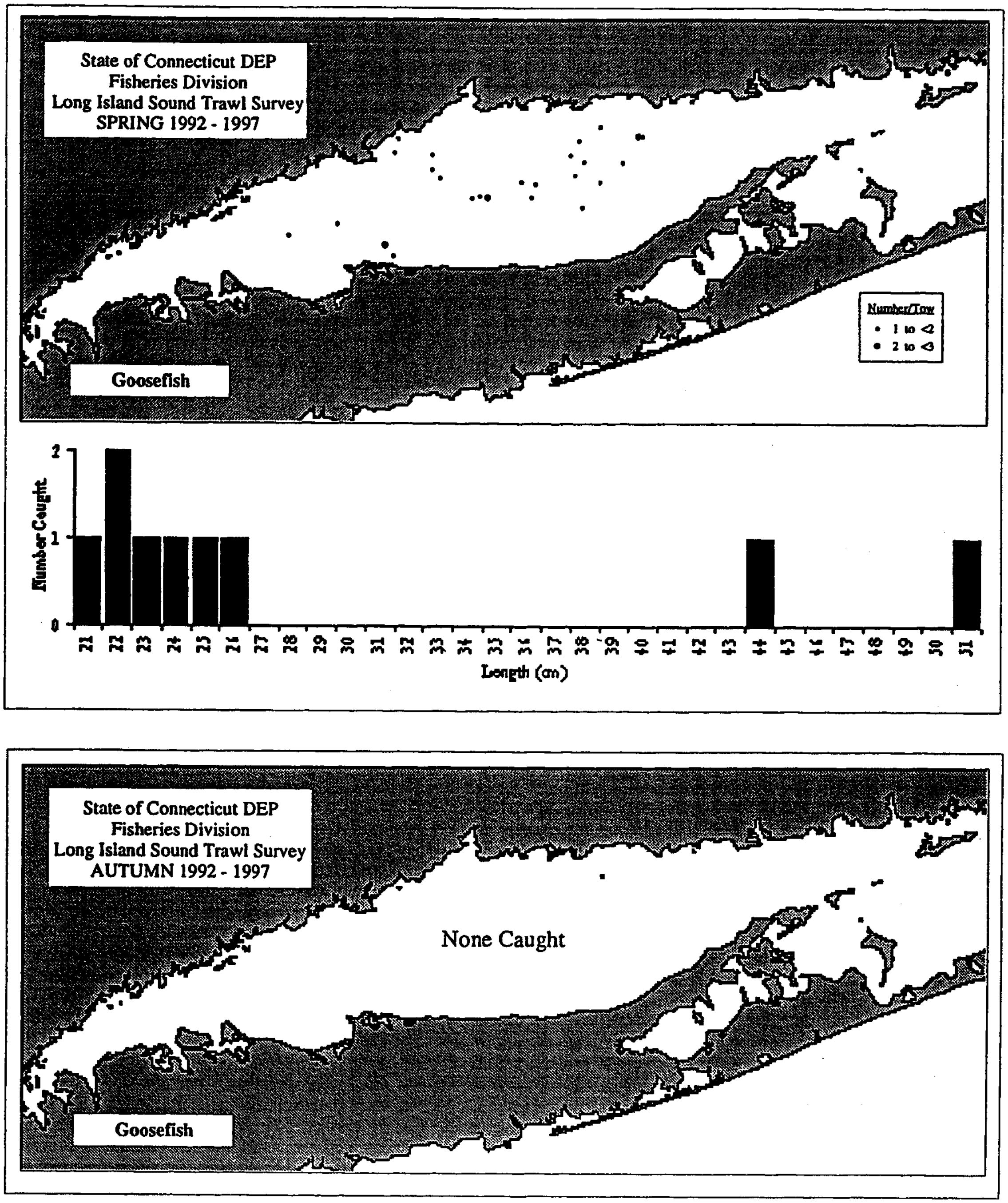
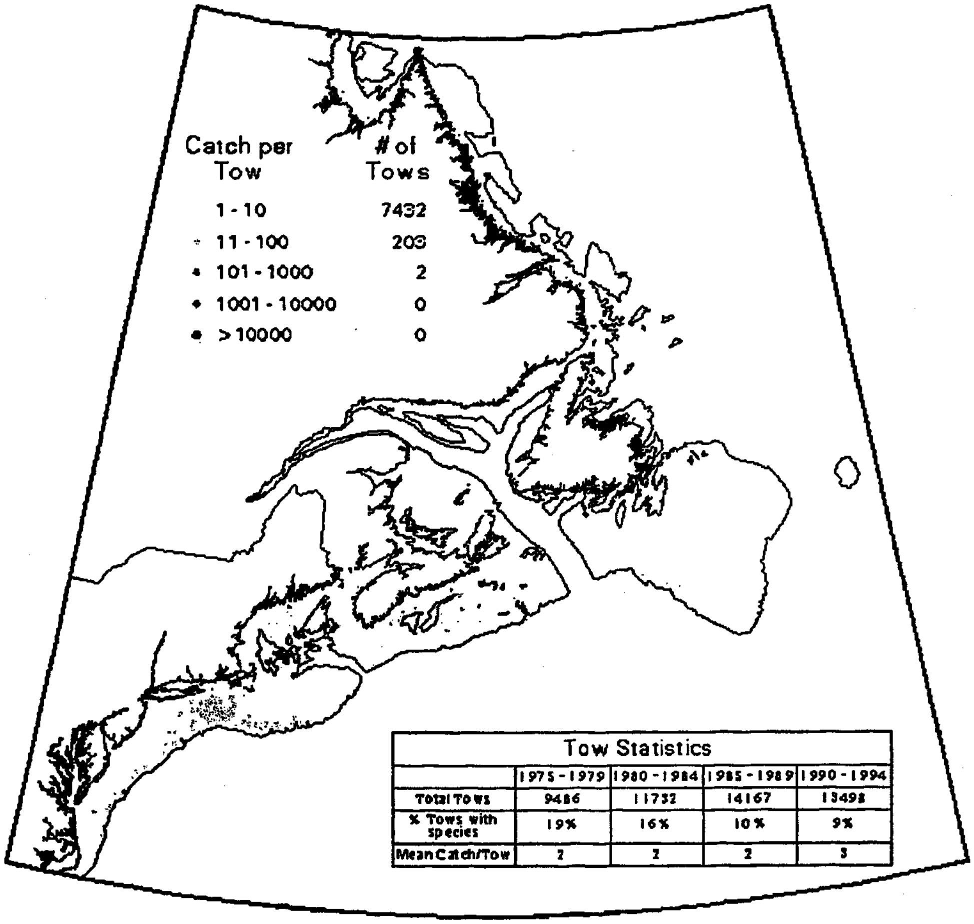


Figure 7. The distribution and abundance and size frequency distribution of goosefish captured in Long Island Sound during the Connecticut bottom trawl survey, 1992-1997 (see Reid 1998).



Tow Statistics				
	1975 - 1979	1980 - 1984	1985 - 1989	1990 - 1994
Total Tows	9486	11732	14167	13498
% Tows with species	19%	16%	10%	9%
Mean Catch/Tow	2	2	2	3

Figure 8. Overall distribution of goosefish in the northwest Atlantic Ocean during 1975-1994. Data are from the NOAA/Canada DFO East Coast of North America Strategic Assessment Project (http://www-orca.nos.noaa.gov/projects/ecnasap/ecnasap_table1.html).

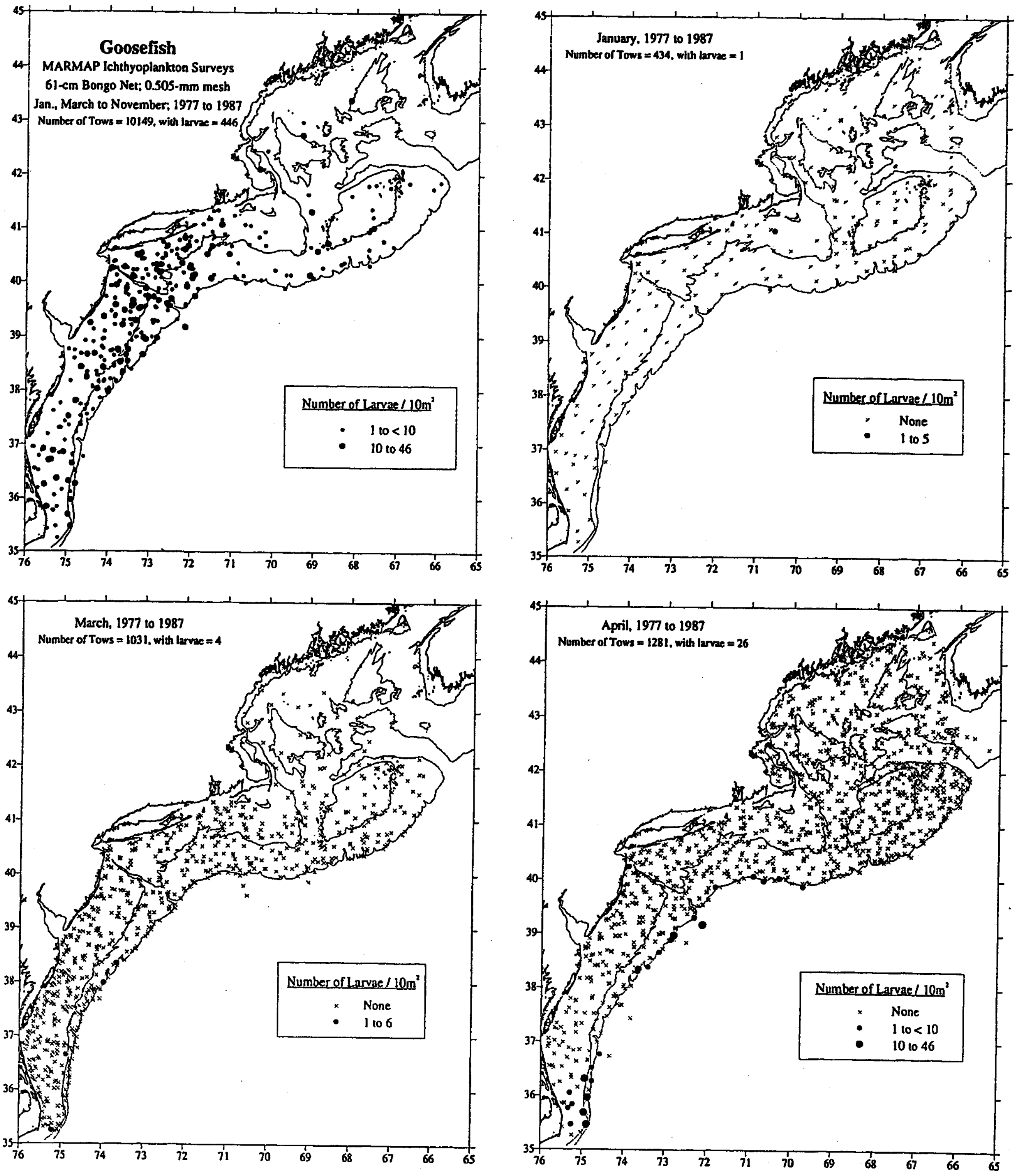
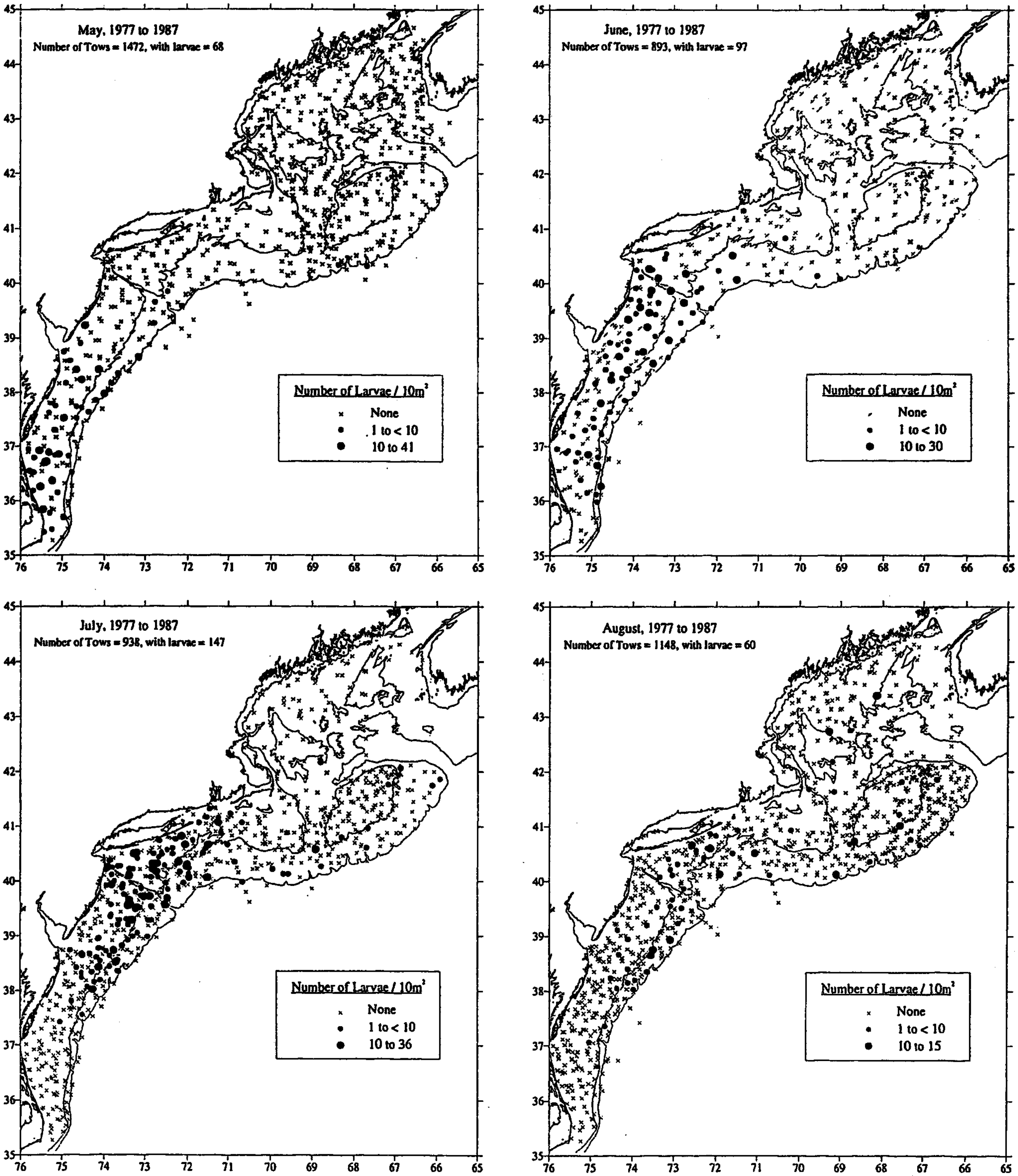


Figure 9. Distribution and abundance of goosefish larvae (overall and monthly) from the NMFS MARMAP ichthyoplankton survey, 1977-1987 (see Reid 1998).



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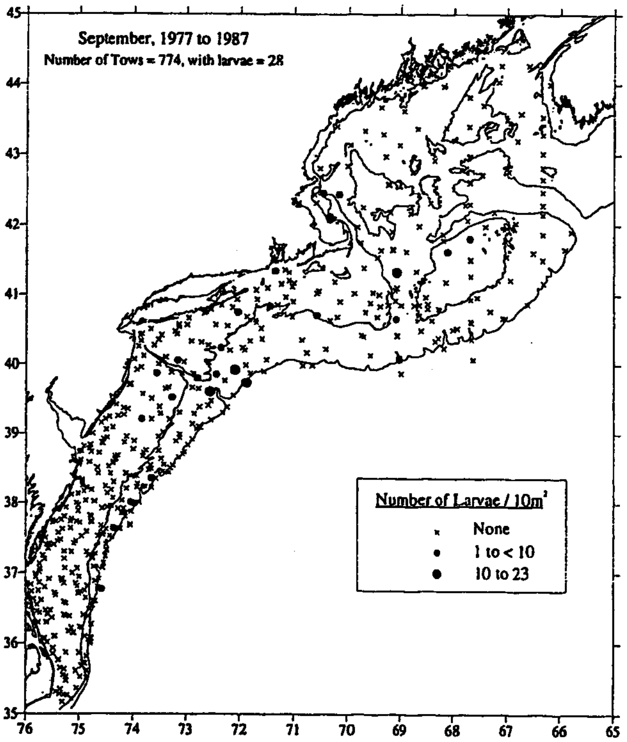

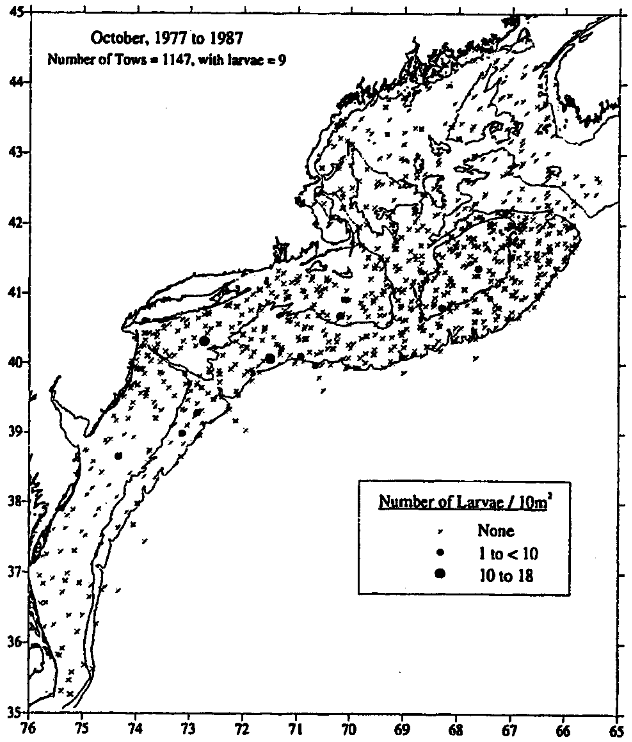

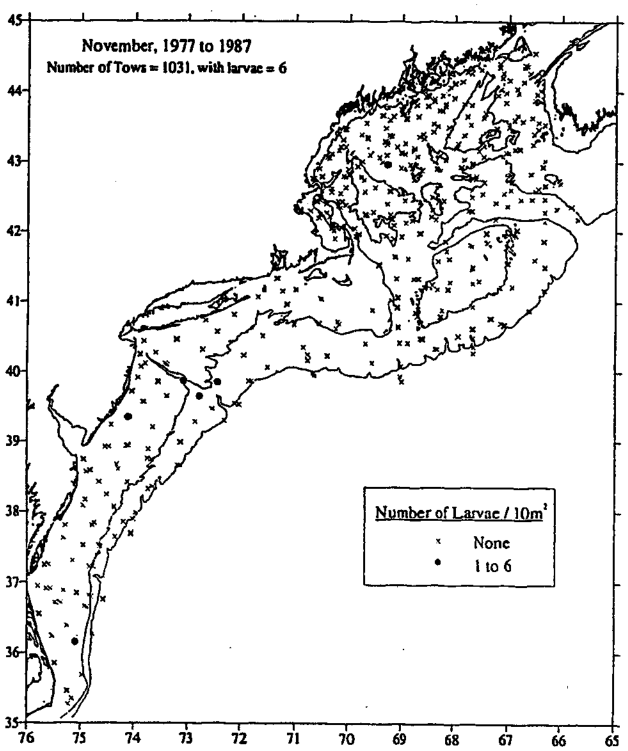

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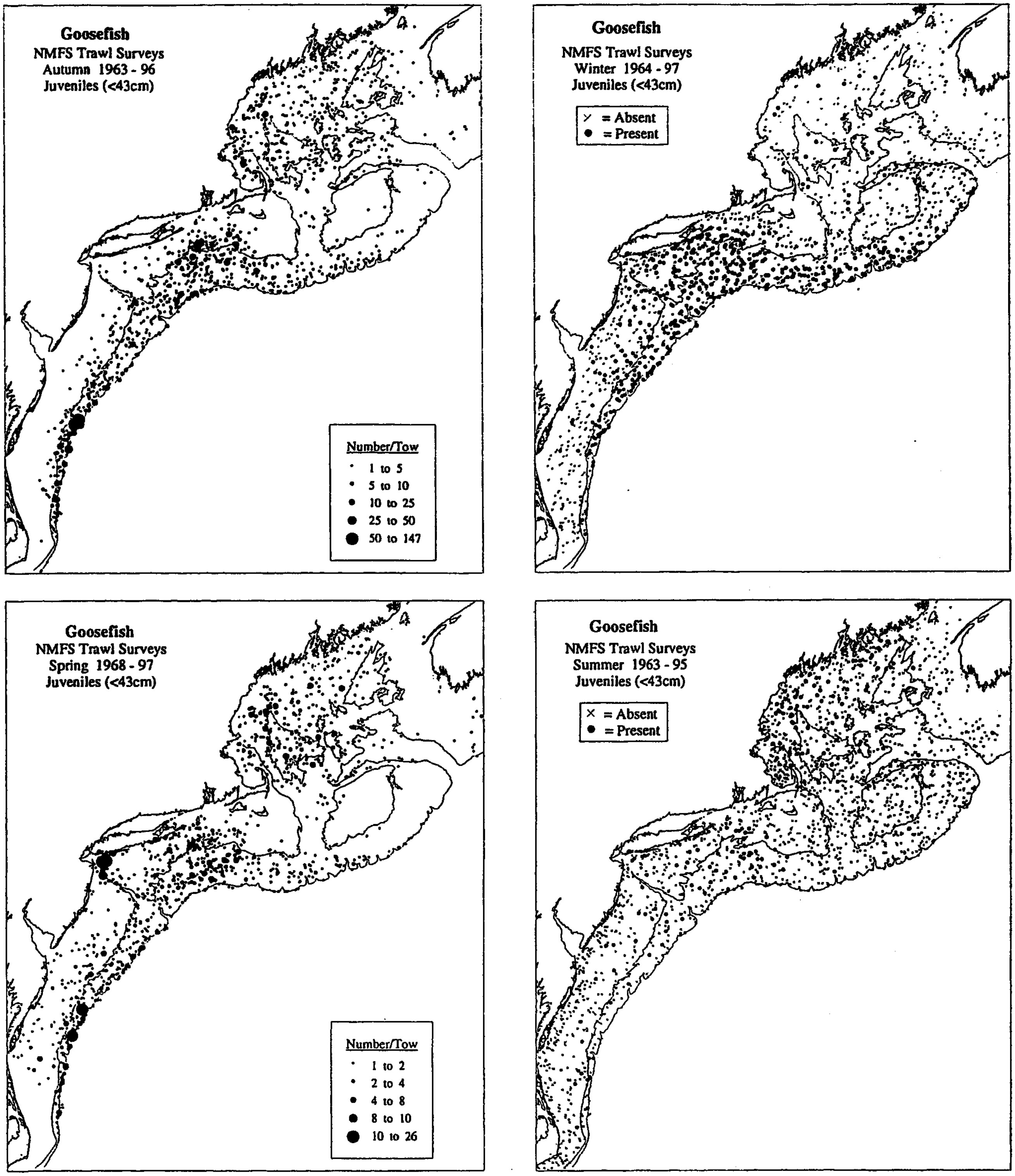
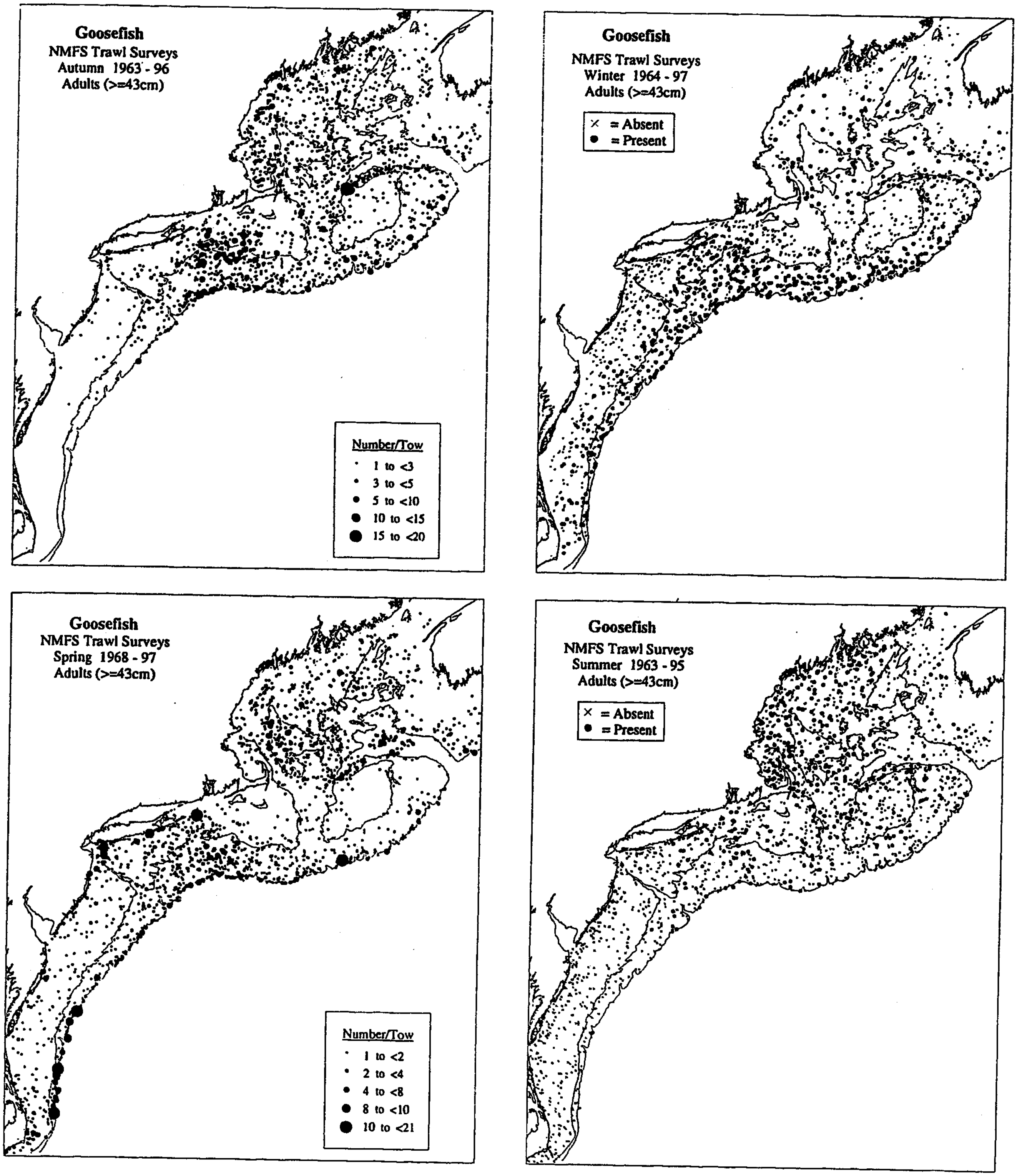


Figure 10. Distribution and abundance of juvenile goosefish collected during NEFSC bottom trawl surveys, 1963-1997 (see Reid 1998).



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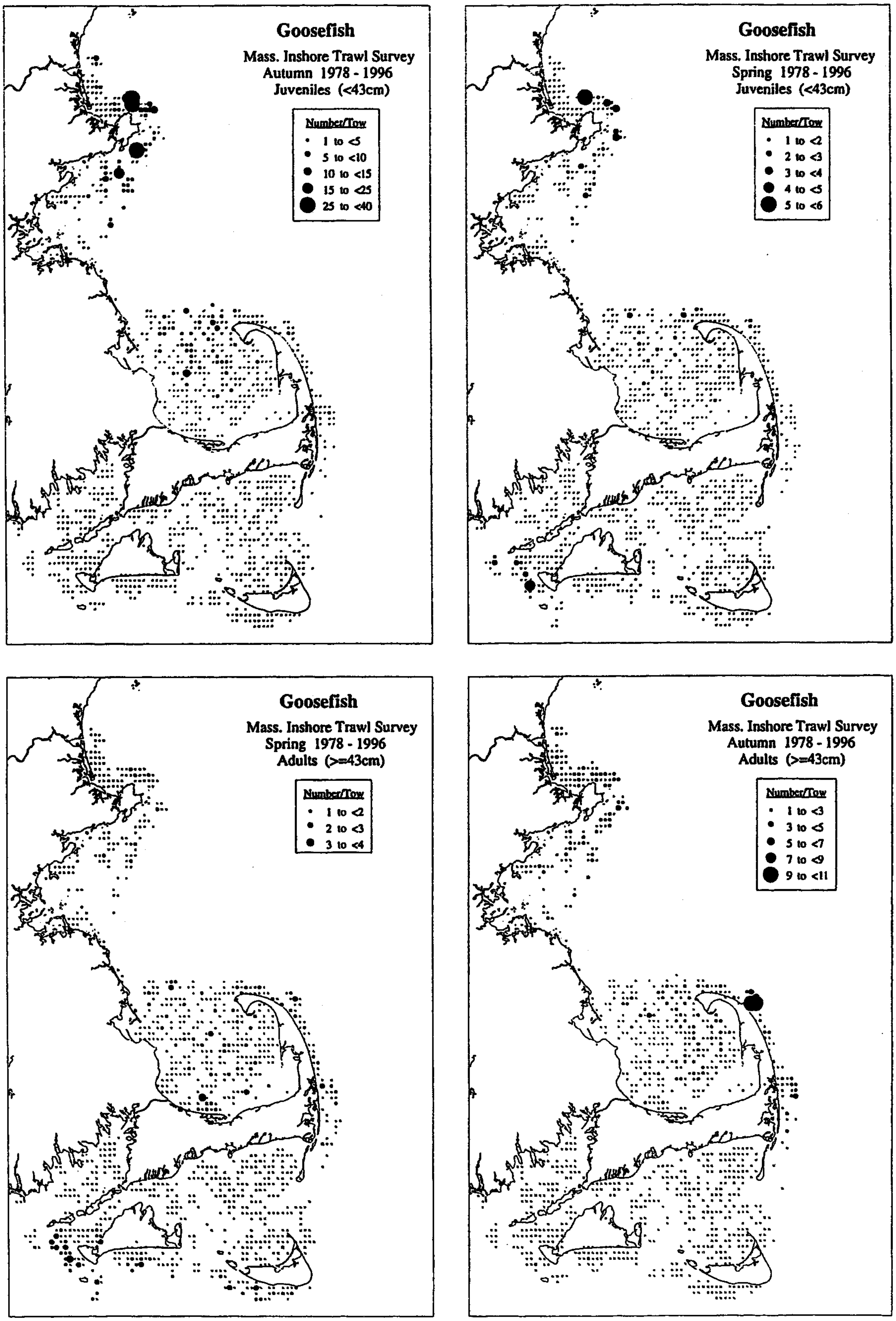


Figure 11. Distribution and abundance of juvenile and adult goosefish collected during spring and autumn Massachusetts inshore trawl surveys, 1990-1996 (see Reid 1998).

Goosefish Juveniles (<43cm)

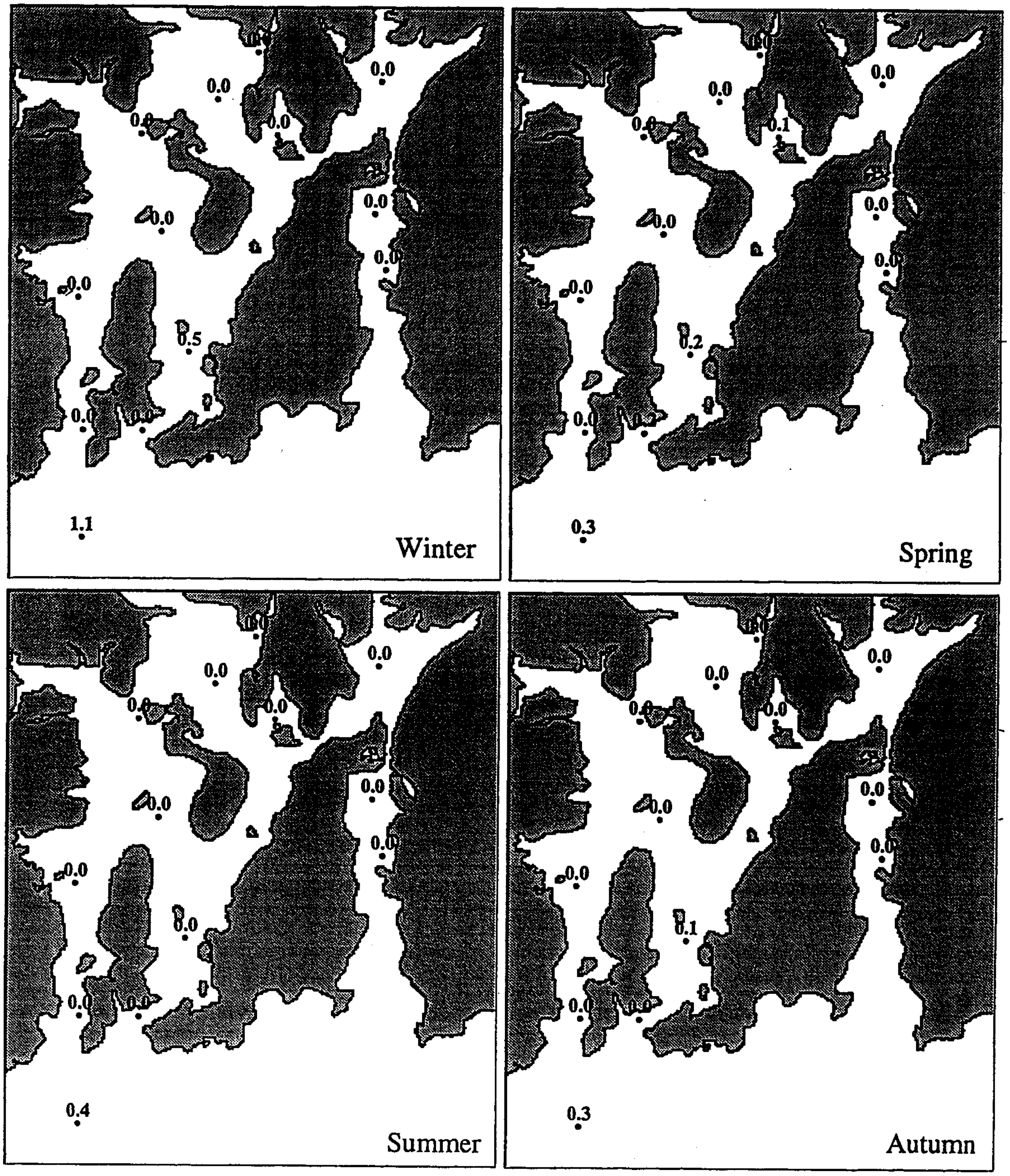


Figure 12. Distribution, abundance, and size distribution of juvenile and adult goosefish collected in Narragansett Bay during Rhode Island bottom trawl surveys, 1990-1996 (see Reid 1998).

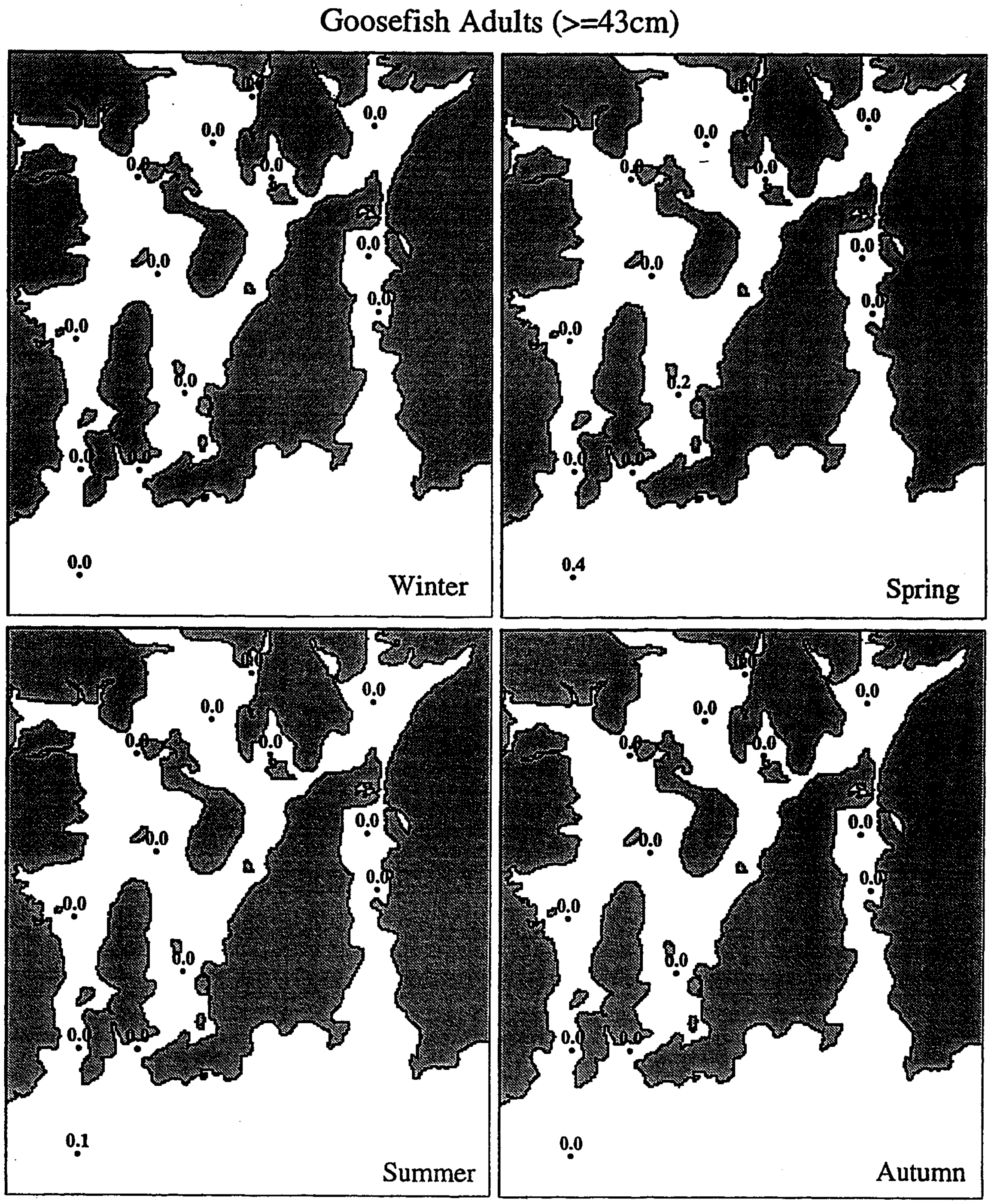
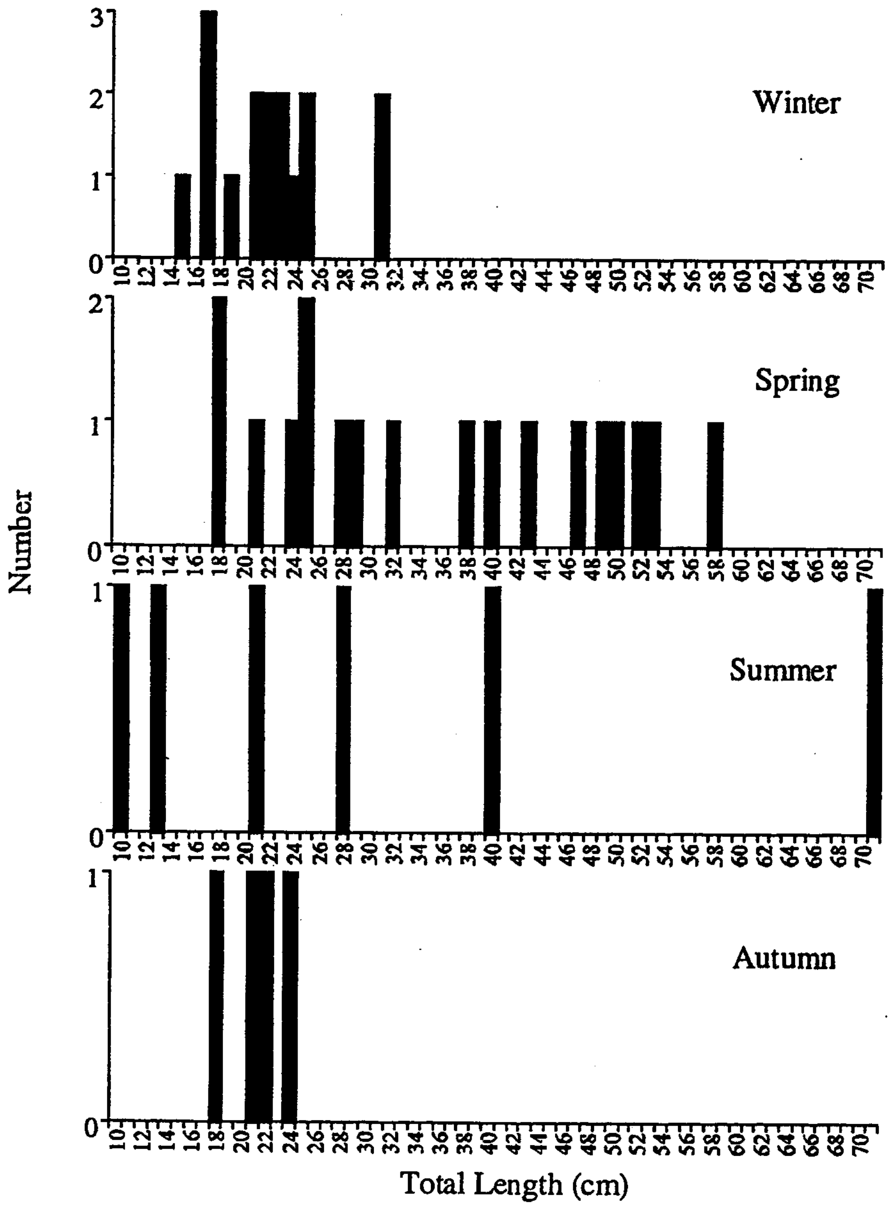


Figure 12. cont'd.



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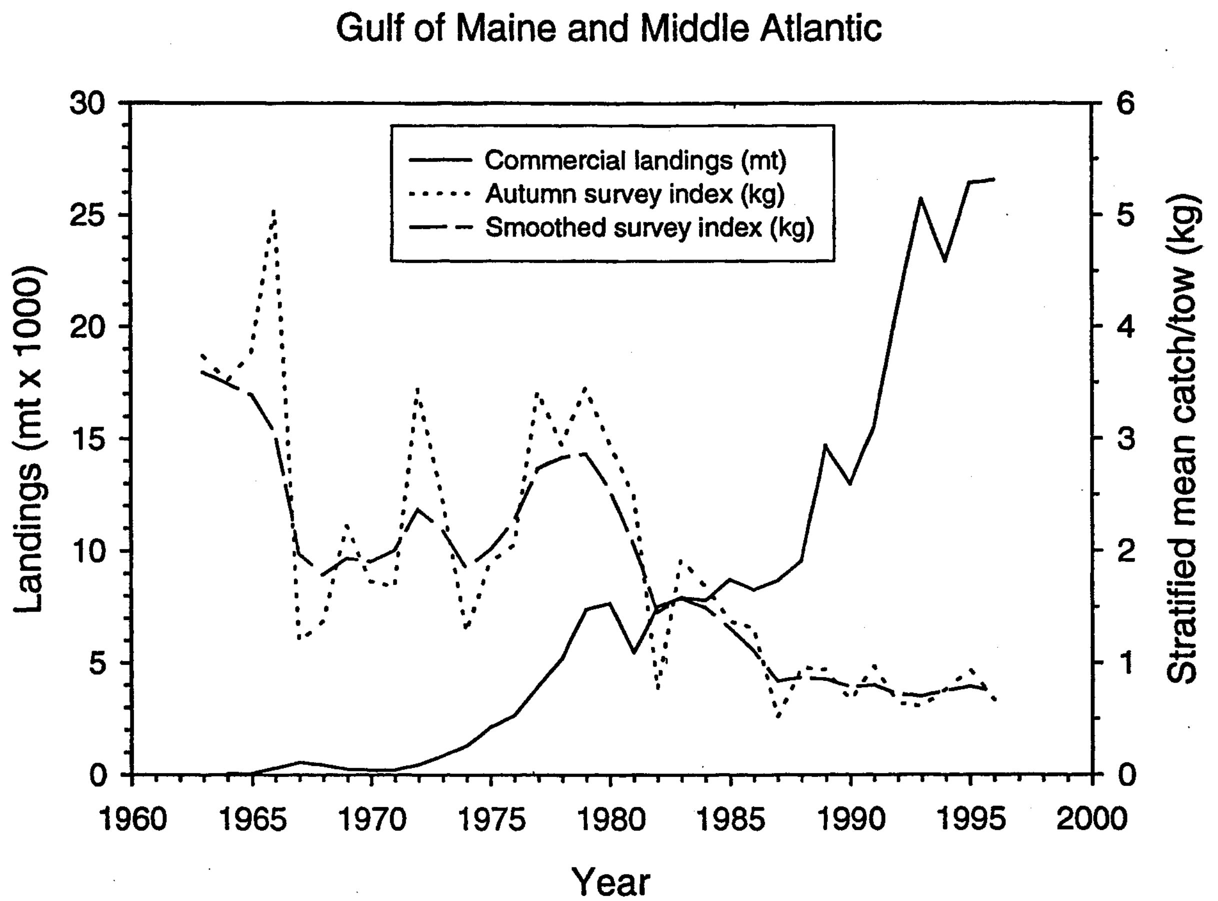

Figure 13. Commercial landings, survey indices, and stock biomass of goosefish in the Gulf of Maine and Middle Atlantic.

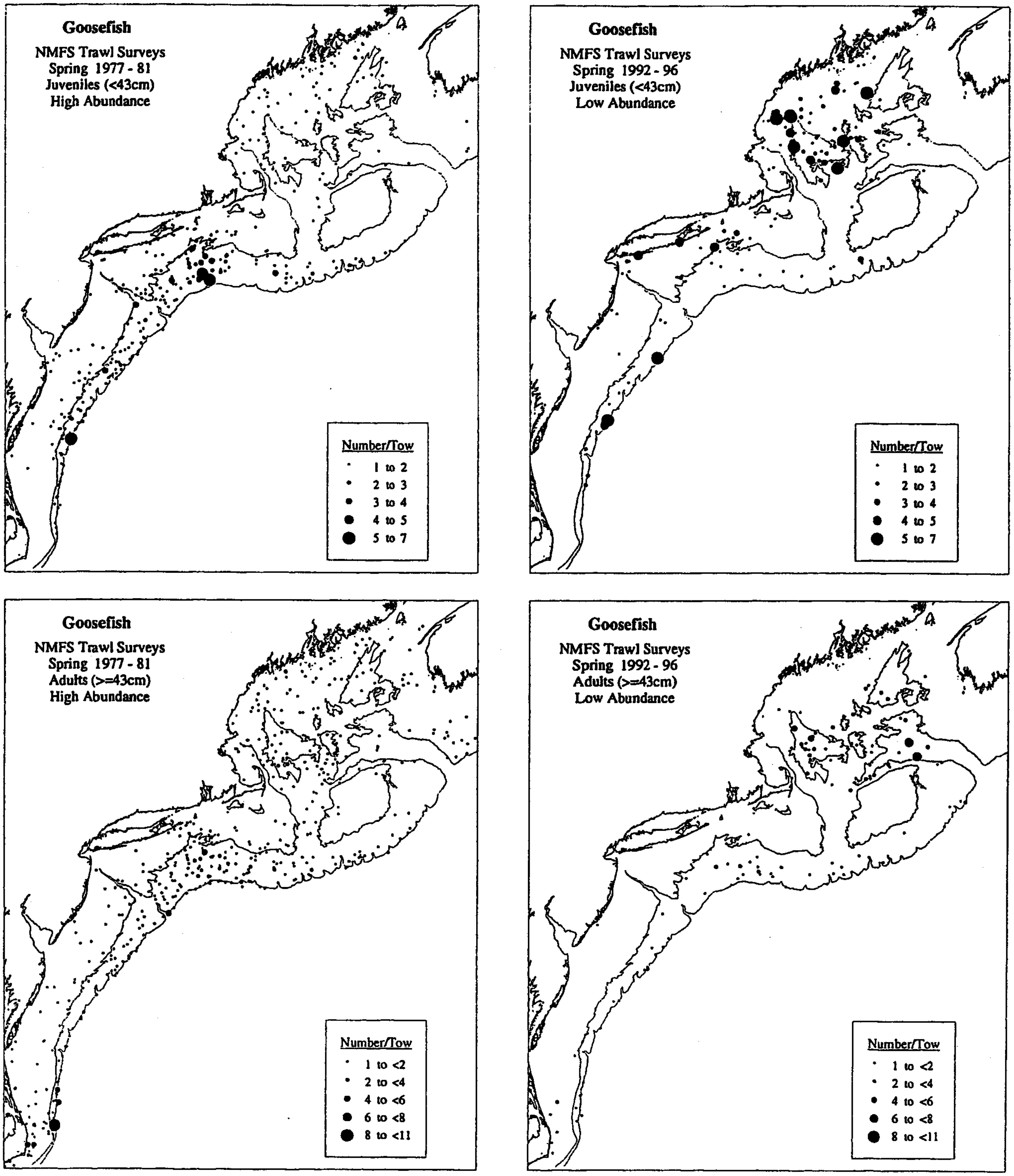

Figure 14. Distribution of juvenile and adult goosefish during periods of high (1977-1981) and low (1992-1996) population abundance, from NEFSC spring bottom trawl surveys.

APPENDIX V

Preliminary Report

THE VALUE OF MONKFISH TO NEW BEDFORD

Daniel Geogiana and Alan Cass

January 27, 1997

PRELIMINARY REPORT

THE VALUE OF MONKFISH TO NEW BEDFORD

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JANUARY 27, 1997

I. INTRODUCTION

According to Status of the Fishery Resources off the Northeastern United States for 1994:

Goosefish, also called monkfish or angler (Lophius americanus), range from the Grand Banks and northern Gulf of St. Lawrence south to Cape Hatteras, North Carolina. Individuals may be found from inshore areas to depths greater then 800 m (435 fathoms). Highest concentrations occur between 70-100 m (38-55 fathoms), and in deeper water at about 190 m (100 fathoms). Seasonal migrations occur and appear to be related to spawning and food availability.

Goosefish has been described as mostly mouth with a tail attached, and reports of goosefish eating prey almost as big as themselves are common. Growth is fairly rapid and similar for both sexes up to age four, when they reach an average length of 19". After this, females grow a bit more rapidly and seem to live longer, about 12 years, reaching a average size about 39". Males have not been found older than age nine, at an average of approximately 35 inches, but few older than age six.

Sexual maturity occurs between ages three and four. Spawning may take place from spring through early autumn (depending on latitude). Females lay a non adhesive, buoyant mucoid egg raft or veil which can be as large as 39 ' long and 5 ' wide. Incubation ranges from seven to 22 days, after which the larvae spend several months in a pelagic phase before settling to a benthic existence at a size of about three inches.

In the U.S., the landed weight of goosefish tails increased from less than 500 metric tons (MT) per year during the 1960s to greater than 6,000 MT in 1992 and 1993. From 1964 to the mid-1970s, the majority of monkfish were taken in otter trawls in the southern Gulf of Maine and northwestern George's Bank regions. In the late 1970s, otter trawl landings increased from Southern New England. At the same time, increasing numbers of goosefish tails were landed by scallop vessels fishing on George's Bank and in the mid-Atlantic.

In New Bedford, monkfish have been caught by scallopers using dredges and occasionally by otter trawls, since fishing began in the port. Few monkfish were landed in the port, however, until the mid-1970s when the supply of the high valued products, such as scallops, cod, haddock, and yellowtail, began to decline. The incidental catch of monkfish brought to the dock by scallopers sharply increased as the price of monkfish rose to $.10 per lb during the mid-1970s. Scallop landings were at a low point during this period, and scallop vessels would save tails to supplement crew earnings.

In the early 1980s, Japan became a market for high quality monkfish livers, which are used for stews and flavorings. The scallopers were the first to enter this market, which paid a premium from October through early March because freshness and high quality could only be guaranteed during the cold months of the year. High prices for livers drew more vessels into the monkfish fishery during these months.

In 1988, whole monkfish were bought by the Japanese at the New York "Fish Port" auction for the first time in the US, and a small market developed for whole monkfish, which were brought to the dock live and shipped live to Japan via overnight air in water-filled aerated plastic bags placed in Styrofoam coffins. During the late 1980s and early 1990s, a larger market developed for whole monkfish, gutted with livers left in; most of this product was shipped to the Korean market. Recently, markets have developed for the meat in the cheeks and belly flaps, although these products make up a very small portion of the monkfish market.

In the mid-1990s, under Amendments 5 and 7 of the Multispecies Plan, New Bedford vessels restricted from fishing in the days at sea (DAS) regulations sought out other species, such as monkfish, skate, and dogfish, which were not under management directives. Scallopers, which had kept monkfish as by-catch, draggers, and gillnet day boats began to target monkfish.

II. New Bedford Monkfish Harvesting Sector

Almost all of the 130 scallop vessels in the New Bedford fleet and most of the draggers in the port fish for monkfish either as by-catch or targeted species during at least part of the year. Monkfish are scraped from the bottom by the chain sweep of the scallop dredge, and draggers trawl for monkfish with specially designed deep-water otter trawls that use a chain sweep to dig into the canyon bottoms. Monkfish do not suffer from narcosis as much as groundfish do and are usually alive when brought aboard. While very few monkfish are landed live, they will live for days on deck in barrels or tanks, using circulating salt water.

When monkfish are brought aboard, fish with a tail less than 7" are dumped overboard and those that are longer than 7" are placed in a checker on deck. The liver and tail are usually removed at the end of each watch and placed in wire or plastic baskets. Some crews cut tails less than 7" and some cut livers from smaller fish. The liver and tails are washed with sea water in baskets. Livers are placed in plastic bags and iced in a shelved pen in the fish hold. Whole fish, usually saved near the end of a trip, are gutted, iced, and layered into the fish hold.

II. 1. NEW BEDFORD MONKFISH LANDINGS

The following statistical description of monkfish landings in New Bedford is based on data reported to NMFS by buyers for 1992 through 1996. These data are reported by product: whole monkfish, livers, and several categories of tails by size, which we combined into a single category for monkfish tails.

Monkfish landings have generally increased in New Bedford between 1992 and 1996 from 5.2 million lb and $6.4 million to 7.4 million lb and $10 million (Figure 1). In 1995, the year that Amendment 7 of the Multispecies Plan went into effect, landings of monkfish reached their highest quantity at 8.2 million lb. Due to record landings and higher prices for livers and tails for 1995, the value of the catch reached $12.6 million (Figures 1 and 2). Most of the increase in monkfish landings and value between 1992 and 1996 have been in livers and whole monkfish (Figures 3A and 3B). Quantities and values of monkfish landings have declined for scallopers and increased for draggers and gillnetters (Figures 4A and 4B).

In terms of product, landings of tails have remained constant at around 5 million lb, except for 1993 and 1995 when landings of tails reached over 6 million lb (Figure 5A). In 1996, landing of tails fell to its lowest point over the 5 year period at 4.8 million lb, but much of this decline in landings of monkfish tails was offset by landings of whole monkfish. The value of tails have remained around $6 million except for 1995 when the combination of higher landings and higher prices for that year caused value to increase to almost $9 million (Figure 5B). Landings of livers have increased steadily from 150,000 lb in 1992 to 470,000 lb in 1996, and value increased from $570,000

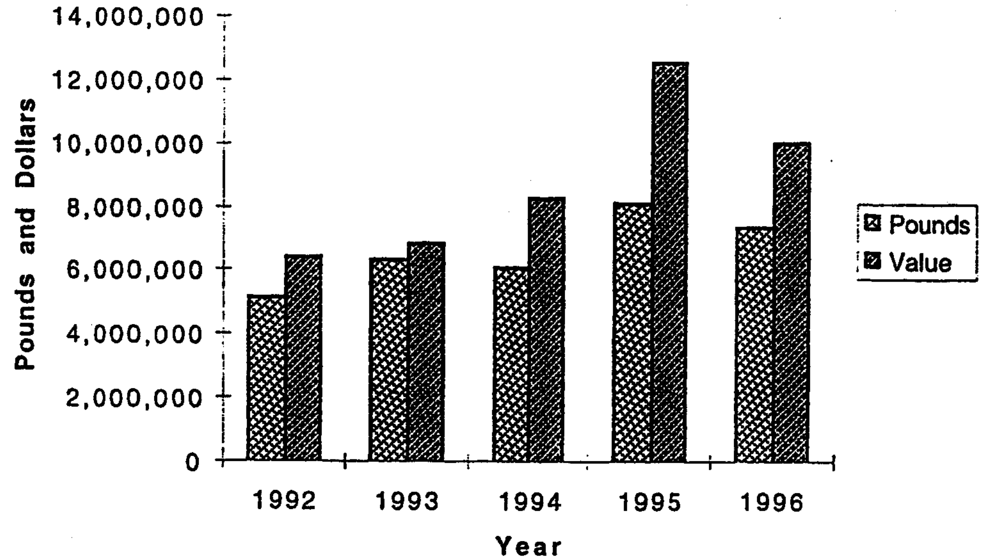

FIGURE 1. QUANTITY AND VALUE OF MONKFISH LANDED IN NEW BEDFORD.

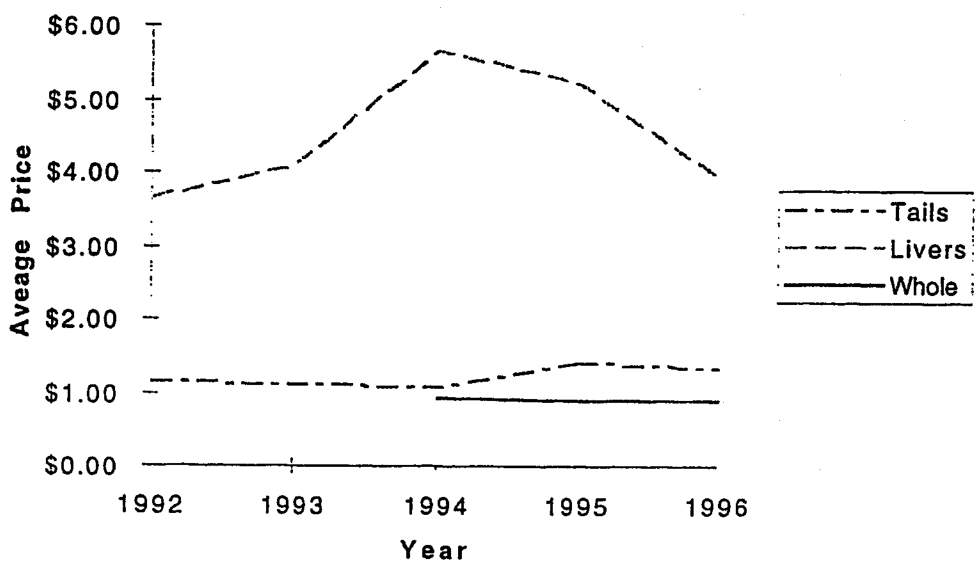

FIGURE 2. AVERAGE EX-VESSEL PRICE PER POUND BY PRODUCT FOR MONKFISH LANDED IN NEW BEDFORD

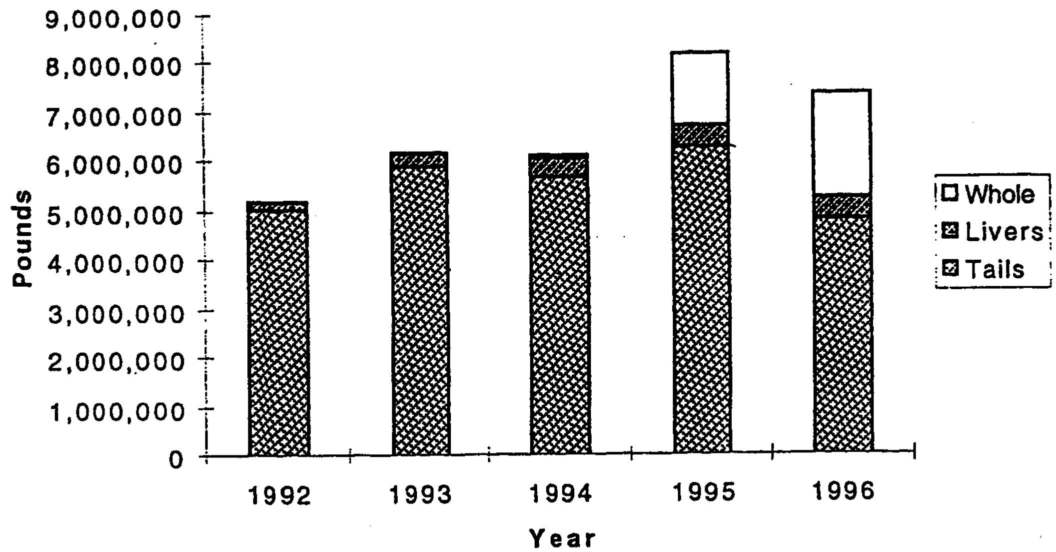

FIGURE 3A. QUANTITY OF MONKFISH LANDED IN NEW BEDFORD BY PRODUCT

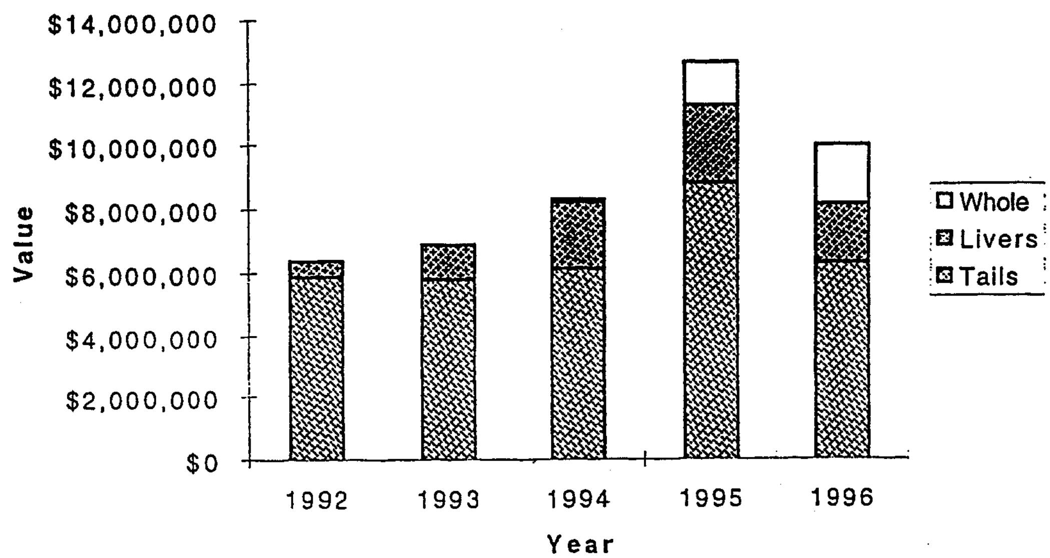

FIGURE 3B. VALUE OF MONKFISH LANDED IN NEW BEDFORD BY PRODUCT

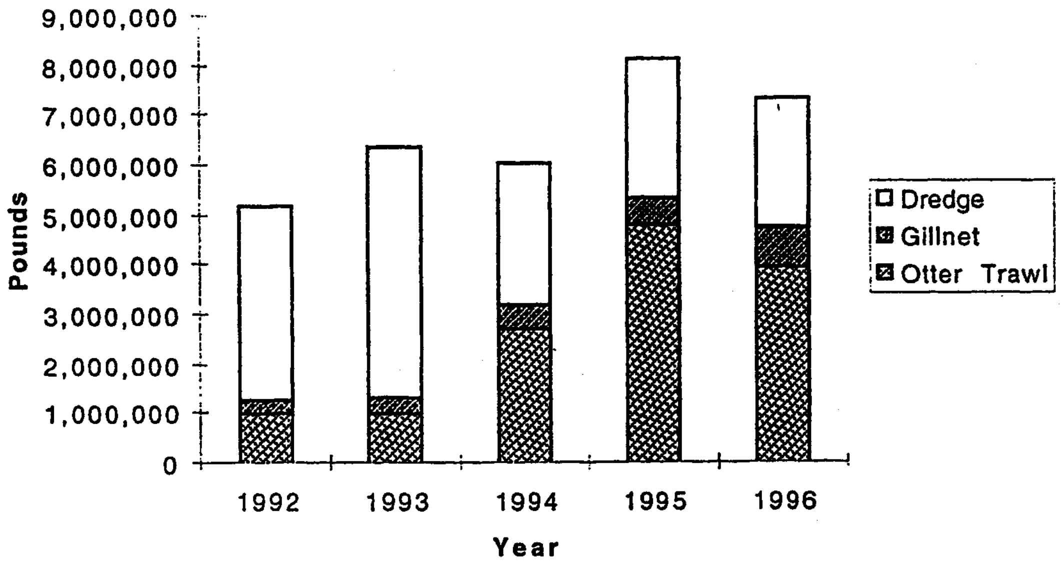

FIGURE 4A. QUANTITY OF MONKFISH LANDED IN NEW BEDFORD BY GEAR TYPE

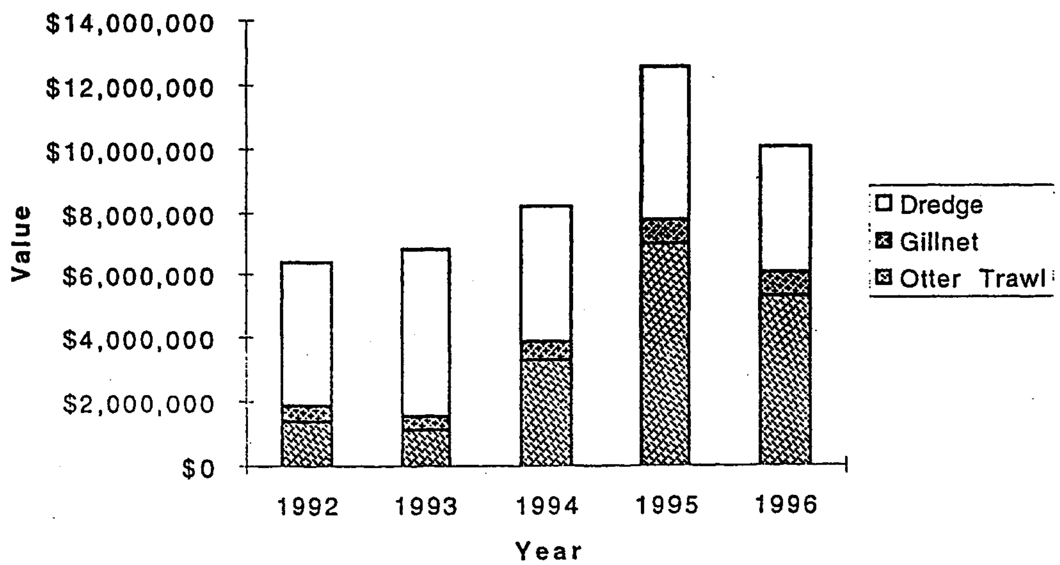

FIGURE 4B. VALUE OF MONKFISH LANDED IN NEW BEDFORD BY GEAR TYPE

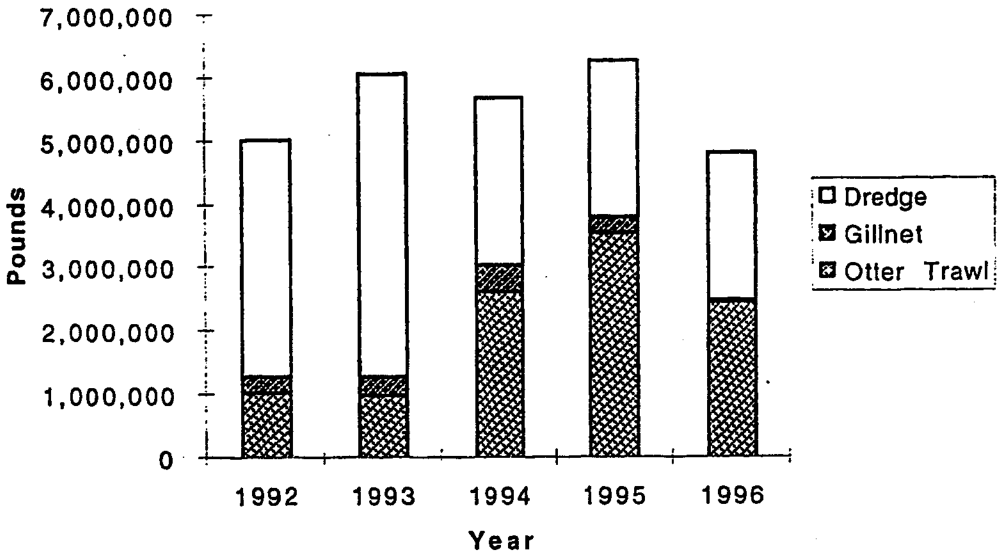

FIGURE 5A. QUANTITY OF TAILS LANDED IN NEW BEDFORD BY GEAR TYPE

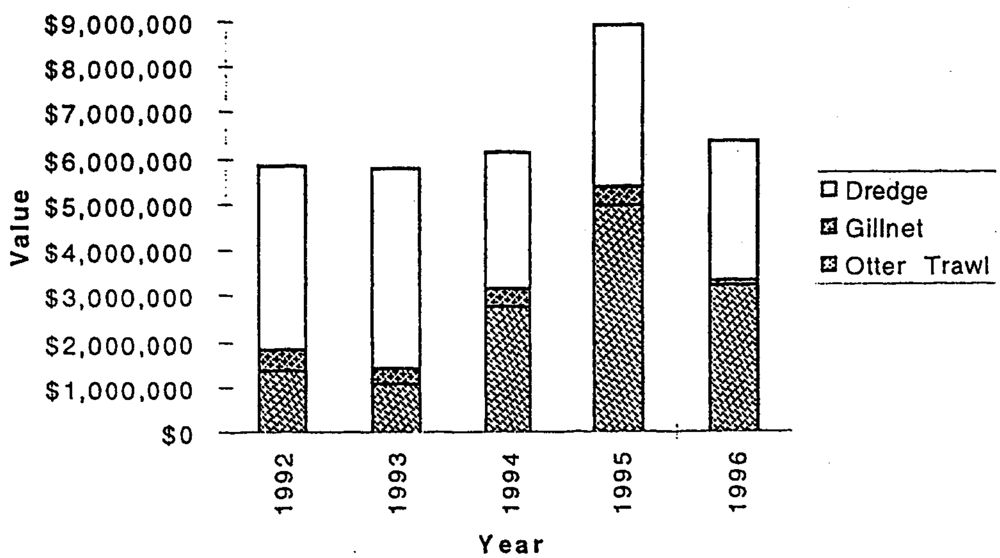

FIGURE 5B. VALUE OF TAILS LANDED IN NEW BEDFORD BY GEAR TYPE in 1992 to $1.8 million in 1996 (Figures 6A and 6B). As with tails, 1995 was a good year for monkfish livers; higher landings and higher prices drove the value of livers landed to $2.4 million. In 1994, value of livers landed was almost as high at $2.2 million. Landings of whole fish have increased sharply from almost zero before 1994 to over 2 million lb in 1996 (Figure 7A). Prices of whole monkfish declined slightly from $.94 in 1994 to $.90 in 1996, but higher landings caused the value of whole monkfish landed to increase from almost zero in 1994 to almost $2 million in 1996 (Figure 7B).

In terms of gear type, landings of tails by scallop dredges have declined from 3.8 million lb in 1992 to 2.3 million lb in 1996 (Figure 5A). Landings of tails by draggers increased from a little over 1 million lb in 1992 to 2.5 million lb in 1996, and landings of tails by gillnets remained around 250,000 lb but rose to almost 500,000 lb in 1994 and then dropped to less than 100,000 lb in 1996. Landings of livers by scallop dredges remained around 200,000 lb for the period, but landings of livers by draggers increased from 9,000 lb in 1992 to 250,000 lb in 1996, and landings of livers by gillnets increased from 5,000 lb to 18,000 lb (Figure 6A). Landing of whole monkfish increased for all gear type, but most of the increase was landed by draggers, from 26,000 lb in 1994 to 1.2 million pounds in 1996, and by gillnets, from 50,000 lb to 750,000 lb (Figure 7A).

II. 2. New Bedford Capital Investment in Harvesting

Scallop vessels have been catching and landing monkfish as a by-catch since the mid 1970s, and scallopers, draggers, and gillnetters have targeted monkfish since the early to mid 1990s. High demand for monkfish products and increasing restrictions on DAS were the main causes for this recent increase in fishing effort on monkfish

In order for scallopers to target monkfish as a directed fishery, which would not count against their DAS, scallop vessels were restricted from having a dredge aboard and therefore had to switch gear to otter trawls. In addition to new nets, net drums, and spacers for winches, scallop vessels required some structural changes to booms, gallows, and decks, in order to target monkfish.

Most scallopers required a net drum to hold the net. Vessels also needed spacers on the winch drum that would hold the longer wire needed to catch monkfish in the deep water canyons of George's Bank and along the

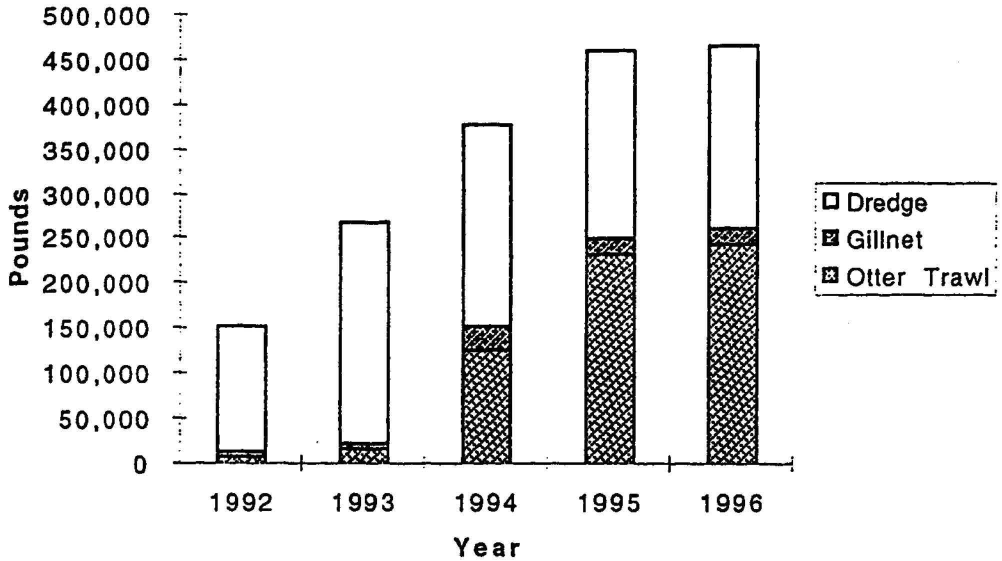

FIGURE 6A. QUANTITY OF LIVERS LANDED IN NEW BEDFORD BY GEAR TYPE

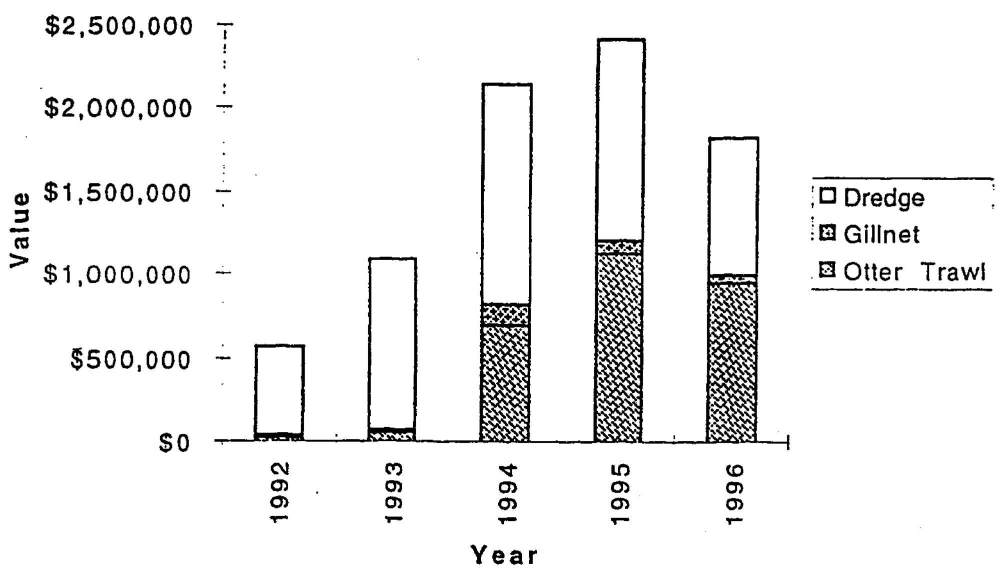

FIGURE 6B. VALUE OF LIVERS LANDED IN NEW BEDFORD BY GEAR TYPE

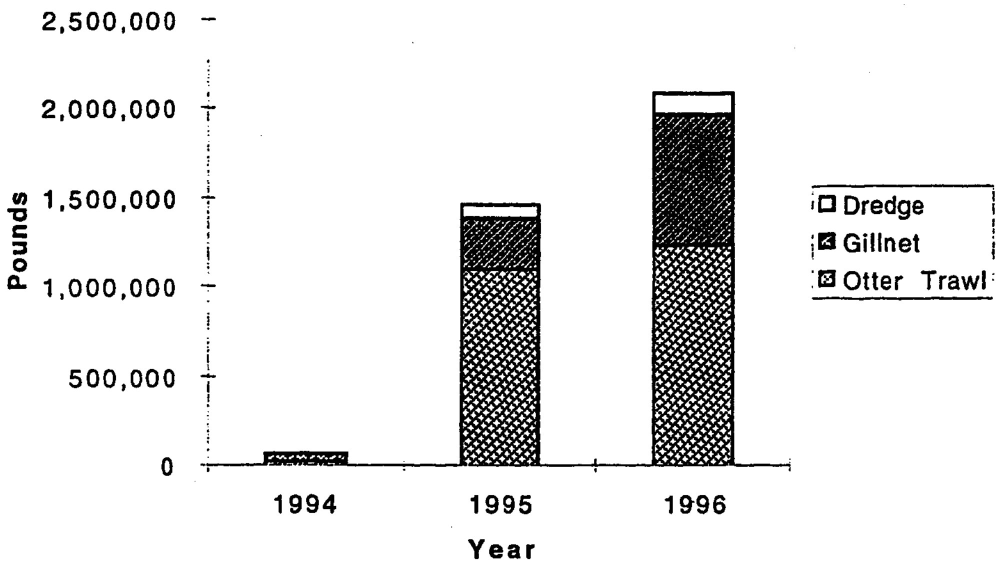

FIGURE 7A. QUANTITY OF WHOLE LANDED IN NEW BEDFORD BY GEAR TYPE

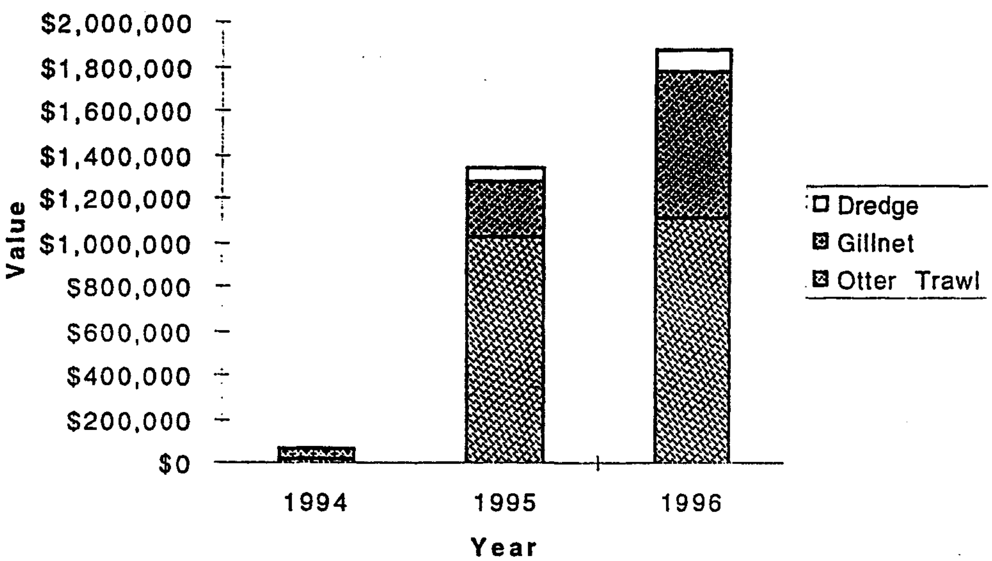

FIGURE 7B. VALUE OF WHOLE LANDED IN NEW BEDFORD BY GEAR TYPE

Continental Shelf. In order to accommodate otter trawls, vessel booms required different style blocks, which held rope whips to maneuver nets coming aboard. Gallows blocks had to be changed to meet the specifications of smaller towing wire diameter for nets. Steel deck sheeting had to be covered with non-slip deck tiles, for safety and insurance reasons, in order for the crew to handle nets and fish between tows.

Net drums cost about $12,000, blocks about $1,300, and decking about $6,000. Nets run an average of $11,500 apiece, doors are $5,500 per set of two, and chain for the net set-up costs $1,500. The average cost to equip these vessels to target monkfish, therefore, was between $40,000 and $50,000. These costs include material and labor for installation.

The capital costs for draggers to target monkfish were about the same as the scalloper costs. Otter trawls for monkfish use larger mesh nets, heavier doors and heavier chain along the bottom rope than otter trawls for groundfish. Blocks needed reinforcement to hold the heavier gear, and in most cases, the drums on the winches needed to be changed to accommodate longer wire.

II. 3. HARVESTING EMPLOYMENT

We estimate that there are about 50 New Bedford vessels, forty-two draggers and eight scallopers, which target monkfish. This does not include gillnet day fishers. Scallop vessels reduce crew members from seven to four or five, when targeting monkfish, and draggers normally stay with the same crew of four to five men. Scallop vessels sometimes have to hire a skipper who is familiar with otter trawls and dragger style fishing. We estimate that total employment in targeting monkfish, therefore, is between 200 and 250 fishermen.

Scallopers and draggers have an incidental catch of monkfish when they target scallops and groundfish. The incidental catch of monkfish on groundfish draggers is smaller than the scallop incidental catch.

III. NEW BEDFORD MONKFISH PROCESSING SECTOR

We identified the monkfish processors in the port, designed a questionnaire to collect information on production, prices, employment, costs, and markets (Appendix A.), and interviewed the 7 monkfish processors in New Bedford. We were successful in gaining information on prices and markets, but we were not successful in gaining sufficient information for production and employment. We decided to use New Bedford landings, adjusted for product loss in processing, for production estimates because we have no reliable estimates for amounts of monkfish that is trucked to New Bedford processors from other ports. We plan another round of interviews to collect a larger sample of production quantity, value, and employment.

Monkfish processors buy tails, livers, and whole monkfish directly from boats, from the Whaling City Display Auction, and from other dealers. Tails are sorted by size, skinned using skinning machines, and most tails and fillets are packed for shipment to France, Portugal and other European markets. Some tails are cut from the bone into one or two fillets. There are fillet machines available to de-bone the tails, but few processors use them. The monk livers are trimmed, sized and checked for nicks and scraps before being packaged and shipped fresh to Japan. Whole monkfish is washed and repackaged for shipment. When the quality of the whole monkfish is questionable, the tail and liver are removed. Shipping is inter-modal using trucks, air transport, and sea transport.

Processors reported an average of 10% loss from skinning tails, 5% production loss on liver processing and about a 28% loss with fillet production from tails.

Figure 8 shows average wholesale prices for tails, livers, whole monkfish, and fillets, obtained from our survey of processors. These estimates of wholesale prices seemed roughly in line with ex-vessel prices. In 1996, after factoring for waste, the value added in processing by product was $.53 for tails, $2.50 for livers, $.30 for whole monkfish, and $.73 for fillets. Value added includes processing cost (except for cost of raw material), packaging, transportation, and processors mark-up. Using the quantity landed and the wholesale price for tails because we did not receive information about the percentage of tails processed into fillets, we estimate that the New Bedford wholesale value for 1996 as $9 million for tails, $3 million for livers, $2.5 million for whole monkfish for a total wholesale value of $14.5 million. We have probably underestimated wholesale value in the port because monkfish landed in other ports is probably trucked to New Bedford, and some tails are processed into fillets.

We were not successful in obtaining sufficient information on processing employment to construct a careful estimate of employment.

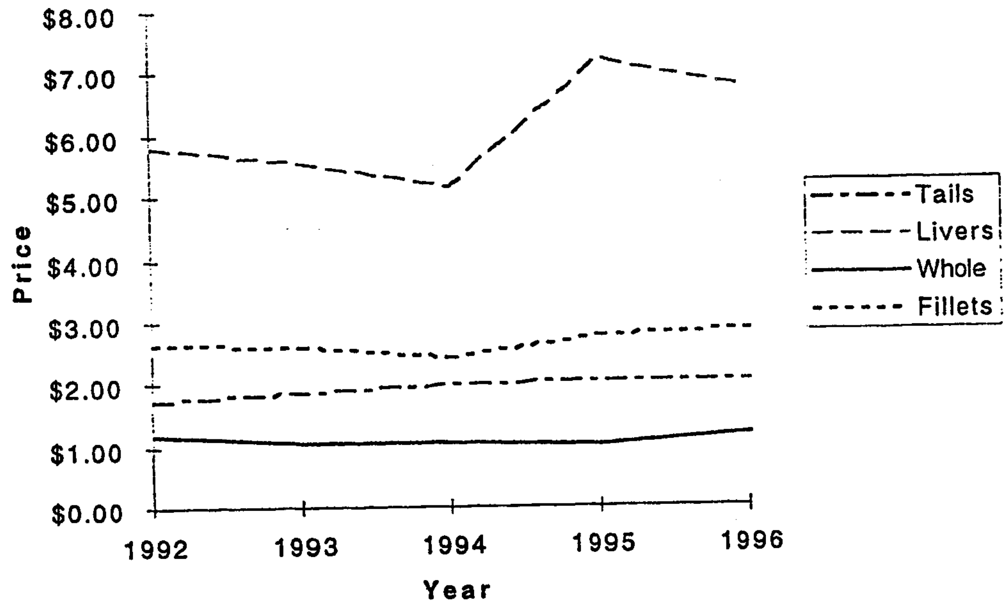

FIGURE 8. WHOLESALE PRICES FOR PROCESSED PRODUCT IN NEW BEDFORD (SOURCE: UMASS DARTMOUTH SURVEY DATA)

Employment in monkfish processing is also highly seasonal. Likewise, we were not successful in obtaining sufficient information on capital costs associated with monkfish processing to construct a careful estimate of the value of capital equipment used to process monkfish in New Bedford.

The results from the interviews indicate that about 20% of tails are sold to the U.S. market and the remaining 80% are sold to buyers in Portugal, Spain, France, and Italy. All livers are sold into the Japanese or U. S. domestic market, and all whole monkfish are sold into the Korean market. About 15% of fillets are sold to the U.S. market with the remaining 85% sold to buyers in France.

IV. CONCLUSIONS

Several conclusions may be drawn from analysis of our survey data and of NMFS landings data:

- New Bedford is an important port for monkfish in the U.S. In 1996, New Bedford accounted for about 30% of tails, 40% of livers, and 30% of whole monkfish landed in the U.S.

- Monkfish have become an increasingly important species in New Bedford, increasing from 4 % to 10 % of the value of landings in 1992 and 1996. Some of this increase in monkfish's share in the ports catch was due to the increase in the value of monkfish landings from $6.4 million to $10 million over this period. But the main cause was the drop in the port's ex-vessel value from $152 million to $101 million over the same period.

- Many vessels have continued to stay in business because of their landings of monkfish. New Bedford vessels which directed their efforts towards monkfish were seeking relief from the DAS regulations of the groundfish and scallop plan amendments. They now have few alternatives, because of increasingly restrictive DAS on the port's primary species, scallops and groundfish, and because of the declining stocks of skate and dogfish. More prevalent species, such as herring and mackerel, require different gear and better markets for their products.

- Investment in gear and equipment to fish for monkfish was substantial. The 50 or so New Bedford vessels that target monkfish have spent between $40,000 and $50,000 per vessel for a total of between $2 million and $2.5 million in capital investment.

- The value of monkfish landings were spread around the port. We estimate that between 200 and 250 fishermen are employed in the direct fishery and virtually all scallopers and most draggers share in the by-catch. Other employment in firms supplying services to vessels and employment in processing also depend upon monkfish landings.

- Using a conservative assumption that only monkfish landed in New Bedford were processed there, we estimate that New Bedford's wholesale value of monkfish products was $14.5 million in 1996 or $4.5 million in value added from processing. The actual quantity and value of processed products, which we plan to estimate from a survey of processors, was probably higher, because monkfish is trucked to New Bedford from other ports. Few if any alternatives remain for New Bedford processing firms, trying to adjust to Amendment 7.

- These products are not being dumped into a declining market, as seem to be the case with other alternative species. Until the recent drop in Asian demand due to their financial problems, monkfish prices remained high, even as landings increased, indicating a strong demand for monkfish products.

- Monkfish skippers and processors have reacted to changes in markets and fishing conditions. Draggers and gillnetters increased their landings of livers and whole monkfish, in response to rising prices relative to tails.

V. ACKNOWLEDGMENTS

The authors wish to thank Eric Thunberg, Economist at the Northeast Fisheries Science Center, NMFS at Woods Hole and Dennis Main, Port Agent, NMFS at New Bedford for supplying data on monkfish landings. We also thank Kathy Downey and Armando Estudante, vessel owners and processors, for their insights into monkfish processing and marketing.

V. APPENDIX A

Monkfish Vessel Survey

Vessel Name: ____
Owners Name: ____
Owners Address: ____
Owners Tel.: ____

1. Cost of fishing gear to go monkfishing:
   - Net ______________
   - Doors ______________
   - Chain ______________
   - Wire ______________
   - Other; (Please identify)
     ____
     ____
     ____

2. Cost of vessel fabrication to go monkfishing:
   - Winches ______________
   - Blocks ______________
   - Stays ______________
   - Decking ______________
   - Other(Please identify)
     ____
     ____

3. Average costs by vessel for monkfishing only per year:
   - Engine ______________
   - Transmission ______________
   - Electronics ______________
   - P&I, Hull Insurance ______________
   - Bookkeeping ______________
   - Other; (Please identify)
     ____
     ____

4. Labor Changes from other type of fishing to monkfishing:

	Type of fishing __________	Monkfishing
# of Crew	__________	__________

5. Did you have to hire a new captain for monkfishing?
   Yes ( ) No ( )

6. Typical average costs while monkfishing per trip?
   - Fuel ______________
   - Oil ______________
   - Filters ______________
   - Food ______________
   - Ice ______________
   - Health Insurance ______________
   - Other (Please Identify; such as knives, bags, etc.)
     ____
     ____
     ____

7. Type of share system while monkfishing?

	Vessel Share	Crew Share
Broken	______________	______________
Clear	______________	______________

   Or other type of lay: ________________________________

8. What trip costs are crew from lay system used?
____
____
____

9. What trip costs are vessel from lay system used?
____
____
____

10. Amount of time spent per year monkfishing?
    - # of Trips ______________
    - Days per trip ______________ (Dock to Dock)

11. Steam time to monkfishing area?
    Days ______________ and / or Hours ______________

12. Do you use lumpers?
    Yes ( ) No ( )

13. How are lumpers paid?
    - By Crew members $______________ per lumper
    - or By Vessel $______________ per lumper

14. Average number of lumpers used per trip ______________

15. Average gross stock (revenue) from monkfishing for?
1992 _$_____________ per trip
1993 _$_____________ per trip
1994 _$_____________ per trip
1995 _$_____________ per trip
1996 _$_____________ per trip

16. What percent of yearly gross stock came directly from monkfishing for?
1992 ________%
1993 ________%
1994 ________%
1995 ________%
1996 ________%

17 What alternative, outside DAS, use of vessel other than monkfishing, if any?

VI. APPENDIX B

Monkfish Processor Survey

1. Firm Name, Address, Telephone Number

2. Name of Person Interviewed

3. Firm Activity: Processor ( )   Wholesaler ( )

4. Current employment used for Monkfish processing only;

	Number	Average Wage (including Benefits)
Permanent	------	--------------
Temporary	------	--------------
Contract Out? with whom?	------	--------------

5. Supply Base: % Supplied to your company from

	Tails	Livers	Whole
Vessels	-----	-----	-----
Wholesaler	-----	-----	-----
Auctions	-----	-----	-----
Canada	-----	-----	-----
Other	-----	-----	-----

6. Per unit Labor cost.

	Whole	Tails	Livers	Fillets
Cost	------	------	-----	------

7. 1992-1996 by year. Volume sales and average sale price.

	Tails lb. /price	Livers lb. /price	Whole lb. / price	Fillets lb./price
1992	____/____	____/____	____/____	____/____
1993	____/____	____/____	____/____	____/____
1994	____/____	____/____	____/____	____/____
1995	____/____	____/____	____/____	____/____
1996	____/____	____/____	____/____	____/____

8. Current customers. % Volume or Share of Marketed Product

	Tails	Livers	Whole	Fillets
USA	------	------	------	------
International	------	------	------	------
Major Country (exported to)	------	------	------	------

9. Average cost to process per lb:
Product loss during production by % of weight : _______%

Labor	$____________
Packaging	$____________
Transportation	$____________
Freezing	$____________
Ice	$____________
Advertising	$____________
Office	$____________
Other	$____________

10. Capital Improvement Costs to process Monkfish. How much money was spent on developing Monkfish processes by your firm?

Equipment	$_________
Rent (if only used for monk processing	$_________
Initial development investment	$_________
Developing market	$_________
Phone - Fax	$_________
Leased space	$_________
Office	$_________
Advertising	$_________
Travel	$_________

14. Alternative use of Monkfish processing machinery and labor.

APPENDIX VI

DEEPWATER FISHERY, POPULATION STRUCTURE, AND

EFFECT ON TAC CALCULATIONS

New England Fishery Management Council
5 Broadway, Saugus, Massachusetts 01906
(617) 231-0422 FTS 565-8457

Chairman
Joseph M. Brancaleone

Executive Director
Douglas G. Marshall

DATE: December 5, 1995

TO: Monkfish Oversight Committee

FROM: Andrew Applegate

SUBJECT: Deepwater fishery, population structure and effect on TAC calculations

At its last meeting, the TAC technical working group re-evaluated the basis for the TAC calculations (see memo dated November 24, 1995). Several factors were discussed, including the potential that monkfish caught in deep water (greater than 100 fm) should be considered separately from those caught inshore. The working group suggested plotting the geographical distribution of the survey tows, overlaid on the distribution of landings by ten-minute square. They also recommended showing how the TAC calculations would be affected if monkfish in deep water were treated as a separate stock and if survey results were available from the deep water areas.

The working group has not been able to reconvene and review these results. The information however is rather straight-forward and the results are unlikely to change. The summary of the commercial landings and research survey distribution was prepared through considerable effort by Josef Idoine and Lisa Hendrickson at the Northeast Fisheries Science Center.

Figure 1 shows the geographical overlap of interviewed commercial trips that landed monkfish and survey observations from 1990 to 1993, inclusive. Survey tows with no monkfish catch are displayed in orange. Survey tows with monkfish catch are plotted in red and scaled to the number caught. There is a considerable frequency of tows without monkfish catch, but the survey is designed to sample a wide variety of species and in many cases occur in locations where monkfish are not as frequently caught by the commercial fishery.

The landings data appear to adequately represent the fisheries that are known to occur. Landings appear to be concentrated inshore along Northern New Jersey. There is also another concentration of landings inshore near the eastern end of Long Island and south of Rhode Island. These landings primarily come from a gill net fishery targeting monkfish. Monkfish landings from the scallop fishery can readily be seen offshore of New Jersey and extending south into the Delmarva region. These landings also appear near the South Channel area, southeast of Massachusetts. Some of the monkfish landings from the edge of Georges Bank also come from trips by scallopers. Monkfish landings also appear to be concentrated in the deep water of the Gulf of Maine and on some of the banks to the northeast of Massachusetts. These landings primarily come from the deep water mixed species trawl fishery and from a directed gill net fishery, respectively.

Very few landings come from the 10 minute squares in deep water where no survey samples were taken during the four year period. Only 697 mt (6.9 percent) of a total 10,059 mt displayed in this plot come from these unsurveyed offshore strata. Total commercial landings in the southern area account for 58.5 percent of the total US EEZ landings. These offshore landings in unsurveyed strata therefore only comprise 11.8 percent of total monkfish landings from the southern area.

Although they have much deeper depths than the areas sampled by the research survey, unsurveyed 10 minute square strata that have commercial monkfish landings are no more than 20-30 miles offshore of areas sampled by the survey. Seasonal migrations of monkfish over these short distances are certainly possible. Additional evidence of homogeneity comes from the number per tow at length. Survey abundance by depth strata (Figures 2 and 3) do not suggest a separate population of predominately large fish in depths over 165 fm (300 m). Just as many large fish between 60 and 100 cm total length occur in shallower depths. If anything, there appears to be proportionally fewer small fish at these depths.

There are three possible reasons why there do not appear to be more large fish at greater depths. Similar rates of fishing would induce similar size distributions. Biological factors besides fishing that could also explain a homogenous size distribution include migration of fish between areas and a slower growth rate in deeper waters. The most likely factors causing a similar size distribution is probably the combined effects of fishing and migration between inshore and offshore.

Hypothetical TAC calculation

For discussion of the possible ramifications of a separate deep water fishery and calculation of a TAC on that basis, the following hypothetical example was developed. Due to the lower rate of exploitation applied on deep water monkfish, we would observe many more fish at larger sizes. This expectation is especially relevant before vessels began targeting monkfish offshore.

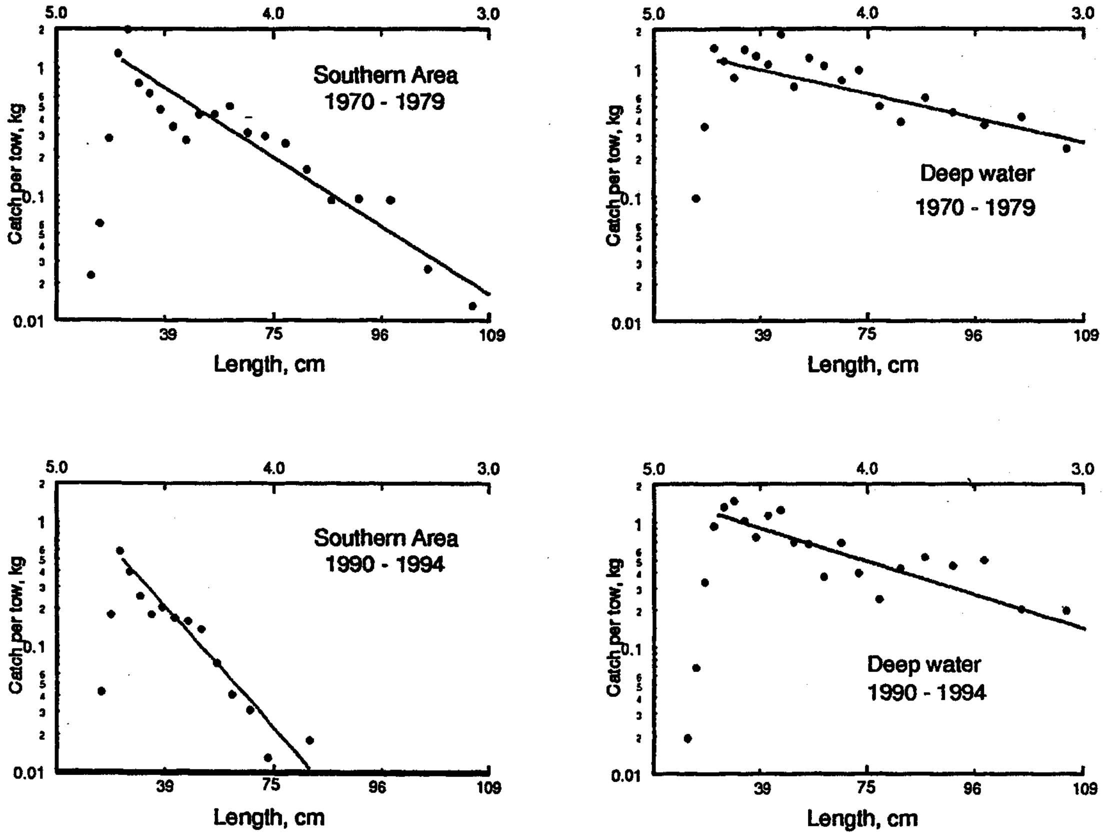

Figure 1. Aggregate and hypothetical deep water decline of number per tow at size from NEFSC autumn survey data, plotted on a log-log scale. More rapid declines in the numbers of large fish, indicated by the slope of the lines, translate into higher total mortality.

The fishing mortality rate for the southern area during 1970-1979 was estimated to be 0.217. A hypothetical example of the size structure at a much lower exploitation rate was developed with the same methodology adopted by the working group. Fishing mortality was set at 0.02, ten percent of the value estimated for the southern area, and the resulting number at length distribution incorporated the level of sampling variability found in the real data. This hypothetical data is shown in the upper right plot of Figure 4. In the more recent period, fishing mortality is still assumed to be only 13 percent of the values estimated for the southern area. An example of the size distribution at this fishing mortality rate is shown in the lower right plot in Figure 4. This assumption is probably a conservative estimate of the change in fishing pressure in deep water areas.

Using the same formulas that were applied to the aggregate southern area by the TAC technical working group, the calculated TAC based on a disaggregated stock complex is shown in Table 1. This disaggregation and the low rate of fishing mortality for the deep water monkfish gives a lower total TAC than previously estimated. Of course, if separate shallow and deep water stock exist, the deep water stock might be fished at a higher fishing mortality rate than discussed here. It would only be appropriate however if abundance at age was much different from that found in shallow water. There is no evidence, either from landings or from the deepest survey samples, that a more healthy age structure exists offshore.

Table 1. Estimated fishing mortality and TAC calculations comparing the scientific advice with a hypothetical stock of deep water monkfish.

	Fishing mortality, 1970-1979	Fishing mortality, 1990-1994	Landings, 1989-1993	1996 Total Allowable Catch
Scientific advice				
Southern area	0.217	0.450	10,217	4,927
Hypothetical case				
Shelf	0.217	0.450	9,007	4,343
Deep water	0.02	0.06	1,210	403
Total shallow and deep				4,746

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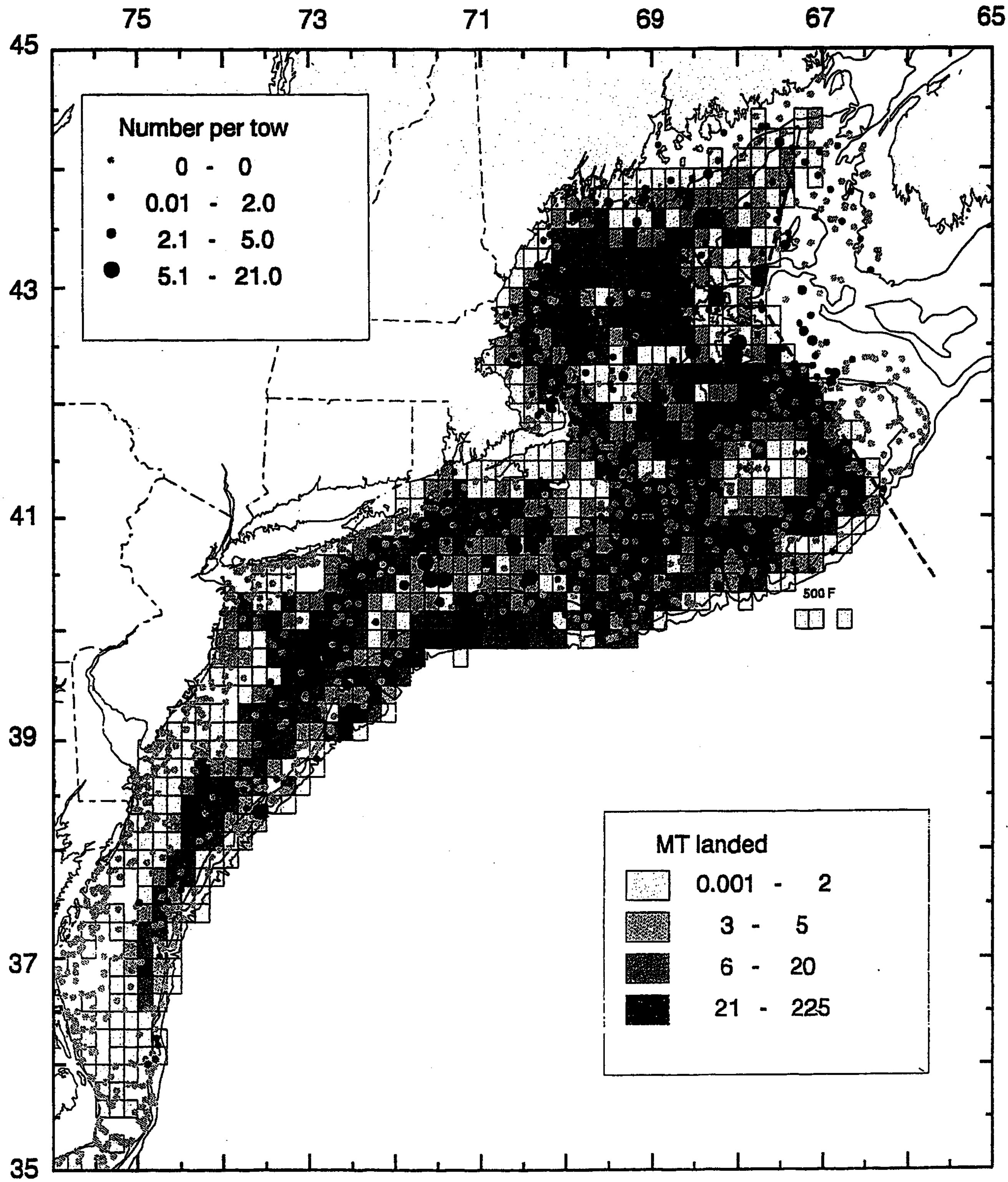
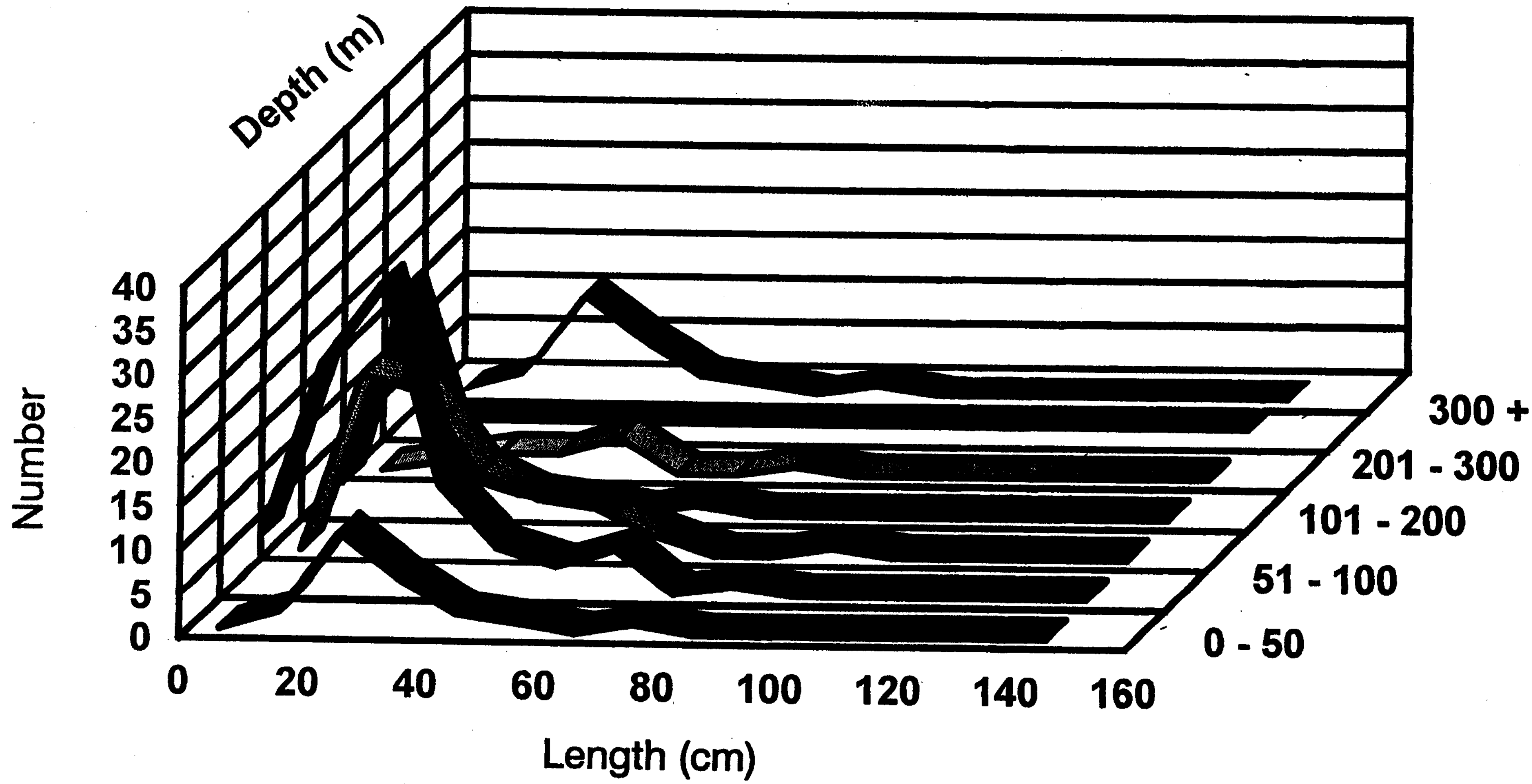
Figure 1.



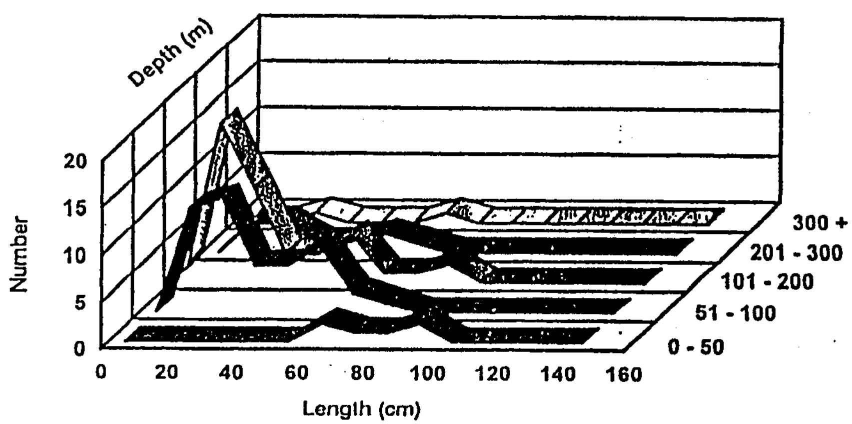
Distribution of goosefish landings (MT), by ten-minute square (interviewed trips), and number per tow caught during NEFSC autumn research survey, 1990-1993. Isobaths are 50, 100 and 500 fathoms.

Figures 2 and 3. Size frequency of monkfish by depth strata from autumn NEFSC surveys, 1990 - 1994.

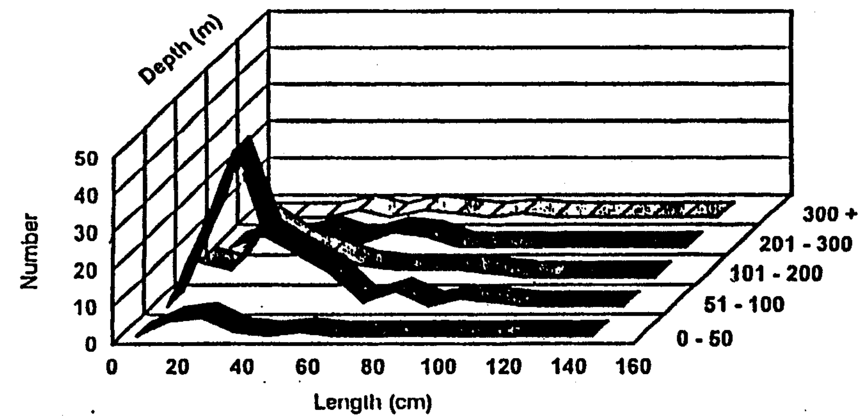
Goosefish: Length vs Depth
1994 Autumn Survey



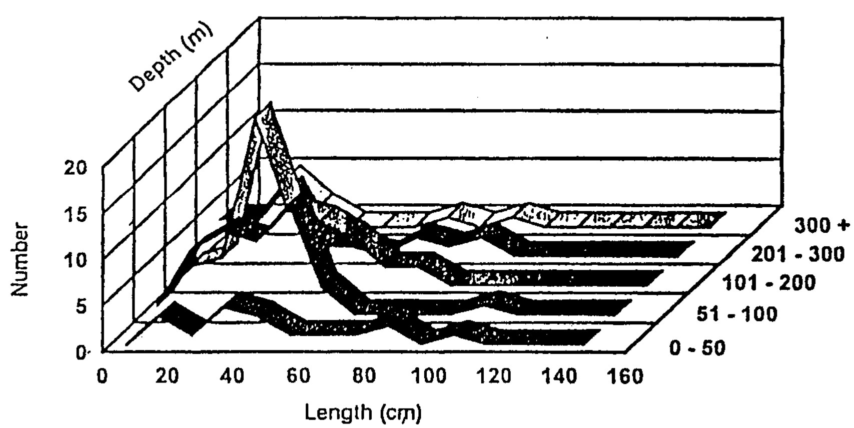
Goosefish: Length vs Depth
1990 Autumn Survey



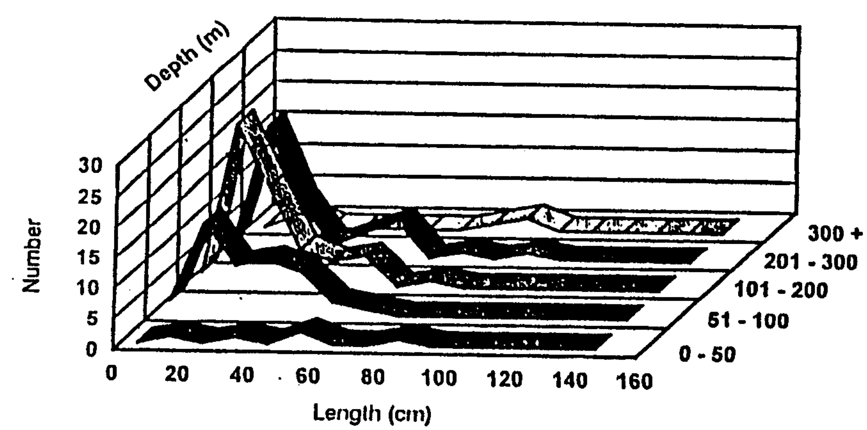
Goosefish: Length vs Depth
1991 Autumn Survey



Goosefish: Length vs Depth
1992 Autumn Survey



Goosefish: Length vs Depth
1993 Autumn Survey



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